

A

NEW MATHEMATICAL
DICTIONARY:

Wherein is contain'd, not only the

EXPLANATION

OF THE

Bare T E R M S,

But likewise an

H I S T O R Y,

OF THE

Rise, Progress, State, Properties, &c.

O F

T H I N G S,

Both in

PURE MATHEMATICKS,

AND

NATURAL PHILOSOPHY,

So far as it comes

Under a *Mathematical Consideration.*

By E. STONE, F. R. S.

Καθαρμοὶ ψυχῆς λογικῆς εἰσιν αἱ μαθηματικαὶ ἐπιστῆμαι.

Mathesis mentis expurgatio.

HIEROCL.

L O N D O N:

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BASE T E R M S

IN I S T O R Y,

OF THE
PROGRESS, STATE, PROPERTIES,

T H I N G S



P U R E M A T H E M A T I C S,

N A T U R A L P H I L O S O P H Y,

U N D E R A M A T H E M A T I C C O N S I D E R A T I O N.

B Y J O H N S T O N, A. A. S.

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A MATHEMATICAL DICTIONARY.



A **BACUS.** This Word has several Meanings; sometimes it signifies an Alphabet, sometimes a Table of Numbers, antiently call'd *Pythagoras's Table*; sometimes a square Trencher; and sometimes a Buffet, or Side-Board. In Architecture it signifies a quadrangular Piece, which serves as a Framing to the Capitals of Columns; and in those of the *Corinthian Order*, represents a kind of square Tile-Covering, a Basket, suppos'd to be encompassed with Leaves.

ABSCISSE, the Part of the Diameter of a Curve intercepted between the Vertex, or some other fix'd Point and an Ordinate. Some call it a *Sagitta*.

ABSIS, the same with *Apss*. Which see.

ABSOLUTE EQUATION, in Astronomy, is the Aggregate or Sum of the Eccentric and Optick Equations.

ABSOLUTE GRAVITY, --- Motion, --- Time, --- Rest, --- Space. See Gravity, Motion, Time, Rest, and Space.

ABSOLUTE NUMBER, in an Equation in Algebra, is that which always possesses one Side of the Equation, and is always a known Quantity, and the Rectangle or Solid under the unknown Roots: As in this Equation, $xx + 12x = 64$, the Absolute Number is 64, as being equal to the Product of the two Roots, or Values of x , viz. of 4 and 16.

ABSTRACT NUMBERS, are those that are consider'd as pure Numbers, without being apply'd to any Subject. And so Abstract Mathematicks is used in Opposition to Mix'd Mathematicks; the former signifying pure

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pure Geometry, or Algebra, and the latter; Opticks, Dialling, Navigation, &c. where physical Considerations are connected with the Mathematical ones.

ABUNDANT NUMBERS, are such, whose Parts added together, make more than the whole Number they are the Parts of; as 12, whose Parts being 1, 2, 3, 4, and 6, added altogether make 16, and the Parts of 20 make 22, &c.

ACCELERATE GRAVITY, — Velocity, — Motion. See Gravity, Velocity, and Motion.

ACCIDENTAL POINT, in Perspective, is a Point in the Horizontal Line, where Lines parallel to one another, not being perpendicular to the Picture, do meet.

ACCLIVITY is a Steepness reckon'd upwards on a Slope Line.

ACCORD, according to the modern *French* Account of Musick, is the Production, Mixture, and Relation of two Sounds; of which the one is grave, and the other acute. They make two Kinds of Accord, those that are pleasant and agreeable, and which they call Concorde; and such as are harsh and unpleasant, which are Discords.

ACHERNER, a bright fix'd Star of the first Magnitude, in *Eridanus*; whose Longitude is $10^{\circ}.31'$. of *Pisces*, and Lat. $59^{\circ}.18'$.

ACHRONICAL RISING, — Setting of a Star. A Star is said to rise or set achronically, when it rises or sets when the Sun sets; and consequently, the Achronical Rising or Set-

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ting is the same as the Evening Rising or Setting. *Kepler* affirms, that these Words are to be taken in another Sense, viz. That for a Star to rise or set achronically, is the same, as for it to arise or set in opposition to the Sun, or in the other Achron or Extream of the Night. In which Sense *Ptolemy*, and to this Day, most Astronomers say a Planet is achronical, when it is opposite to the Sun, and bright all the Night. So that for a Star to arise achronically, is, as commonly, for it to arise when the Sun is setting; but to set achronically, is to set when the Sun is rising. This is one of the three poetical Risings or Settings.

ACRE, a superficial Measure for Land, containing by Statute 160 Square Roods, or Poles.

Whence, if the Side of a Square of Land be 12. 64 Roods, the Area of that Square of Land will be very near one Acre.

ACROTHERIONS are little Pedestals, usually without Bases, placed at the two Extrems, and on the Middle of Pediments. The Word is originally *Greek*, and signifies the Extremity of any Thing.

ACUTE ANGLE, an Angle less than a Right one.

ACUTE-ANGLED CONE, is a Name given by *Euclid*, and the Antients before *Apollonius Pergensis*, for such a Right Cone whose Axis makes an Acute Angle with its Side. And an

ACUTE-ANGLED SECTION of a Cone, was the Name of an Ellipsis made by the Section of an Acute-angled Cone. They did not consider that it could be produced by the cutting of any Cone whatsoever, till *Apollonius* did.

ACUTE-

ACUTE-ANGLED TRIANGLE, a Triangle whose three Angles are acute.

ADDITION. This is either of Numbers in Arithmetick, or Quantities in Algebra.

ADDITION OF NUMBERS, is the Invention of some Number, from two or three given ones of a like kind, which shall be equal to all the given ones; and that Number sought, is called the *Sum*, or *Aggregate*.

ADDITION OF QUANTITIES, in Algebra, is the Connecting together of the several Quantities express'd, either by Numbers, Letters, or both, by their proper Signs, Plus + or Minus —.

ÆOLIPILE, is a round hollow Ball of Iron, Brass, or Copper, furnish'd with a Neck, in which there is a very slender Pipe, opening to the Ball. Sometimes the Neck is made to screw into the Ball; which is the best Way, because then the Cavity may be the more ready filled with Water. But if there is no Screw, you must heat the Ball red-hot, and then throw it into a Vessel of Water, which let run in at the small Hole, till about two Thirds of the Cavity be fill'd. Then if the *Æolipile* be laid on or before the Fire, so that the Water and Vessel do become very much heated, the vaporous Air will fly out of it with great Noise and Violence; but by Fits, and not with a constant and uniform Blast.

ÆRA, the same as *Epocha*. Which see.

ÆTHER. What is commonly meant by this Word, is a very thin Diaphanous Fluid surrounding the Earth, as far as

the Interstellular World, and which easily penetrates and runs through all Things, and lets all Things run as easily through it.

AFRICA, one of the four great Continents of the Earth, containing *Egypt*, *Barbary*, *Biledulgerid*, *Zaara*, Land of the *Negroes*, *Guinea*, *Nubia*, *Æthiopia*.

AFFIRMATIVE QUANTITY. See *Quantity*.

AFFIRMATIVE SIGN is this +.

AGGREGATE, the same as *Addition*.

AIMABLE NUMBERS are such that are mutually equal to the whole Sum of one another's Aliquot Parts; as are these two Numbers, 284 and 220. For 284 is equal to the Sum of all the Aliquot Parts of the second Number 220, which are 1, 2, 4, 5, 10, 11, 20, 22, 44, 55, 110; and the latter Number 220 is equal to all the Aliquot Parts of 284, viz. 1, 2, 4, 71, 142.

AIR, or Atmosphere. An Elastic-fluid Body, encompassing the whole Earth to a great Height, and rushing in to fill up the Spaces left by other Bodies in it, if not hinder'd.

Some of the most noted Properties of the Air are these:

1. From several Experiments made in *England*, *France*, and *Italy*, it appears that the Air becomes denser in the same Proportion as it is more press'd, and expands itself in the same Proportion as the Pressure diminishes.

2. The Force that compresses Common Air, is the Weight of the Atmosphere, or of the upper Parts upon the lower; and the Elasticity or Spring of the Air, is equal to that Weight,

whence the Air is most dense at the Surface of the Earth, where its Pressure upon every Square Inch is about fifteen Pounds Avoir-du-pois, and grows rarer and rarer the higher it is.

4. The Air may be condens'd by Art, so as to take up but the sixtieth Part of the Space it took up before, as is shewn in the *Philosophical Transactions*, N^o 182.

3. Dr. *Halley* has demonstrated, that if Altitudes of the Air are taken in the same Arithmetical Proportion increasing, the Density thereof shall be in a Geometrical Proportion decreasing. But this is on a Supposition that the Air, as you go higher and higher, is of the same Nature as that near the Earth: For Mr. *Cassini*, and *Picard* assisting him, by measuring the Altitudes of several Mountains, diligently observ'd the several Altitudes of the Mercury of the Barometer; and by that Means found that the Proportion of the Rarity of the Air was not according to Dr. *Hally's* Theorem, but much greater than what ought to arise from the said Proportion. See *Hist. de l'Acad. Roy.* 1703. & 1705.

5. The Pressure of the Air, near the Surface of the Earth on any Base, is ballanced by a Column of Water of the same Base of about 35 Feet in Height, or one of Mercury of about 30 Inches. From whence, and Dr. *Halley's* Theorem it follows, that at the Height of 42 Miles, the Expansion of the Air will be 4096 more than at the Surface of the Earth. And at that Height the Altitude of the Mercury in the *Torricellian* Tube will be but a little more than the hundredth Part of an Inch.

The first who observ'd the Ballance of the Air with Water was a Gardener of *Florence*; who wondering that he could not raise Water in a Pump higher than eighteen Cubits, communicated the unexpected Phenomenon to *Gallileo*, who himself did not then know any thing of it, as you find in his *Mechan. Dial.* 1 p. m. 15, 16.

After him several experienc'd the same Thing; among whom was Mr. *Marriott*, a *Frenchman*, who found that Water would not rise higher than thirty two *Paris Feet*. And *Torricellius*, a Scholar of *Gallileo's*, using Mercury instead of Water, found that it would be suspended at about thirty Inches.

6. The Weight of a Cubick Foot of Air is one Ounce and twenty seven Grains, according to *Burcher de Volder*, who was the first Person, next after *Otto de Guericke*, who attempted to weigh the Air; which he did by such nice Scales, that he says, if twenty five or thirty Pounds was put into each of them, the addition to or taking away of but one or two Grains, would make a manifest Preponderation on one Side or other.

Mr. *Boyle* found a Lamb's Bladder, containing about two Thirds of a Point; and blown up and well dried, to lose about a Grain and one Eighth when it was prick'd, and the Air let out.

Mr. *s'Gravesande* found that the Air in a Glass Ball, of about 283 Inches Capacity, weigh'd 100 Grains.

7. The Weight of any Quantity of Air to the same Quantity of Water near the Earth's Surface,

Surface, according to Mr. Boyle, is as 1 to 1000; according to Dr. Halley, as 1 to 800; and according to Mr. Hawksby, as 1 to 885; and the Gravity of the same Quantity of Air to the same Quantity of Mercury, as 1 to 10800.

8. All common Air is impregnated with a certain vivifying Spirit, necessary for the Preservation of the Life of Animals; because without fresh Air they die, as well as for want of it. And this vivifying Spirit in a Gallon of common Air, is sufficient for one Man about the Space of one Minute, and not much longer.

9. The vivifying Spirit in Air is inflammable, or of a Nature proper to feed Fire, and capable of being burnt and consumed thereby.

10. Air that has lost the vivifying Spirit may be call'd a Damp, not because it is fill'd with moist Vapour, but because it deadens Fire, extinguishes Flame, and destroys Life.

AIR-PUMP: A Machine, by Means of which the Air may be drawn out of any proper Vessel.

The Air's Elasticity is the Foundation of this Machine, which is made several Ways; the chief Part in all of them is a Barrel, or hollow Cylinder of Metal, having a Piston moving therein, filling its Bore so exactly, as to let no Air slip by. This Piston is thrust down to the Bottom of the Barrel, and then raised up in such a Manner, as to exclude all the Air from the Cavity of the Cylinder, or Barrel. If this Cavity communicates with any

proper Vessel, by Means of a Pipe at the Bottom of the Barrel, the Air in the Vessel will expand itself, and part of it will enter into the Barrel, so that the Air in the Vessel, and in the Barrel will have the same Density; and if the Communication between the Vessel and Barrel be shut up, and the Air be let out of the Barrel, and the Piston applied to the Bottom of the Barrel, and be raised up a second Time, and the Communication between the Barrel and Vessel above-said, be again open'd, the Density of the Air in the Vessel will again be diminish'd. And repeating the Motion of the Piston, the Air in the Vessel will be reduced to the least Density, but can never be exhausted by this Method.

All Air-Pumps have in common the Parts above describ'd, but they differ in several other Things; for there are often two Barrels; in one of which a Piston is raised, and in the other depressed; which Motion is communicated to them by a Wheel mov'd by a Handle, These being the best Sort.

The first Inventor of the Air-Pump, was *Otto de Guericke*, Consul of *Magdeburg*, who perform'd several Experiments with it at *Ratisbon*, in the Year 1654, before the Emperor, and several other illustrious Persons. Soon after Mr. Boyle having taken the Hint from a Treatise of *Casper Schottus*, entitled *Mechanica Hydraulica Pneumatica*, publish'd in the Year 1657, (tho' he himself says he had not seen the Book,) directed Dr. Hook and another Per-

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son, to contrive and effect a newer and better Air-Pump than *Otto de Guericke's*, which he heard was defective.

In the *Memoirs de Mathématique & de Physique*, for December 1693. you have this general Theorem of Mr. *Varignon's*, concerning the Proportion of the remaining Air in the exhausted Vessel, or Receiver, to that which was in it before you began to pump, viz.

The Quantity of the natural Air contain'd in the Receiver before you begin to pump any out, is always to the Quantity of what remains, after any Number of Pumps; as the Capacity of the Receiver, and the Cavity of the Pump together, (which Cavity is made by drawing up the Piston,) raised to a Power which shall have the Number of Strokes of the Pump for its Index, is to a like Power of the Capacity of the Receiver alone.

Adjutage, is the Spout for a *Fets de Eau* in any Fountain. Mr. *Marriott* affirms, that an even polish'd round Hole in the End of the Pipe, or Tube, will give an higher Jet than either a Cylindrical or Conical Adjutage; but of those the latter is best. Here follows some Proportions of Adjutages and their Tubes.

1. If the Heights of two Tubes, continually full of Water, be unequal, and the Adjutages likewise unequal, then the Quantities of Water spouting out thro' them in the same Time, are in the Ratio compounded of the simple Ratio of the Adjutages, and the subduplicate Ratio of the Heights.

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2. If the Heights of two Tubes continually full of Water be equal, the Water will spout out thro' Adjutages any how unequal, with the same Velocities.

3. If the Heights of Tubes continually full of Water, and their Adjutages be unequal, the Velocities of the Water spouting out, are in the subduplicate Ratio of the Altitudes.

4. Mr. *Marriott* found by Experience, that Water spouting out thro' Adjutages, situate in the same horizontal Line, and made in the same Tube of 2, 4, 6, 10, 12, &c. Lines in Diameter, would spout higher thro' the lesser Adjutages than thro' the greater ones.

ALCOVE, in Architecture, signifies that Part of a Bed-Chamber in which the Bed stands, and which is usually separated from the rest by Pillasters, or other Decorations, forming an agreeable Place of Retirement.

ALDEBARAN, an Arabian Name for a fix'd Star of the first Magnitude, situate in the Head of the Constellation, call'd the Bull, and therefore usually call'd the Bull's-Eye. Its Longitude is in $5^{\circ}, 45', 33''$ of Gemini, and Latitude $5^{\circ}, 29', 14''$ South, and Right Ascension $64^{\circ}, 51', 9''$.

ALGEBRA, is the Method of solving Problems by Equations.

This Art is deservedly reputed the very Apex of human Learning: For by Means thereof, surprising Truths have been found, as well in Natural Philosophy, as pure Mathematics. By this may Geometrical Demonstrations be wonderfully

fully abridg'd, and Problems solv'd, which would be otherwise impossible to be effected; nay, even such a Number of Truths is often express'd in one Line by this Art, as would require a whole Volume to expound and demonstrate, otherwise; and by contemplating one Line for a few Hours, you may learn what would take up a whole Year to be learn'd according to the common Methods.

As to the first Inventers of this Art, we are in the dark; but it is highly probable that the antient *Greeks* knew it, but conceal'd it, being an excellent Secret, because we have some Examples of it in *Theon upon Euclid*, who says it was first communicated by *Plato*. There are also Instances of it in *Pappus*, and in the Writings of *Archimedes*, and *Apollonius*, &c. Its Effects plainly appear, tho' they studiously conceal'd it. But it certainly was in use among the *Arabians* more antiently than among the *Greeks*; and they are supposed to have had it from the *Persians*, and the *Persians* from the *Indians*, and from the *Arabians* the *Moors* and *Saracens* brought it into *Spain*, from whence it came into *England*, and that before we knew any thing of *Diaphantus*.

The first who did write professedly of Algebra, among the *Greeks*, was *Diaphantus*, whose Book was first publish'd in *Latin* by *Xylander* in the Year 1575; but before *Diaphantus's* Book came out, *Lucas Paccioclus*, or *Lucas de Burgo*, a Minorite Friar, publish'd a Treatise of

Algebra in *Italian* at *Venice*, in the Year 1494, as he received it from the *Arabians*, and makes mention of one *Leonardus Pisannus*, and several others, from whom he learn'd it; but we have none of their Writings. He says this Art came originally to us from the *Arabians*, and makes no mention of *Diaphantus*, who, therefore, it is probable, was not as yet known here. After these came out several other Treatises of Algebra; but most of them went no further than Quadratics, yet in some few there are the Solution of some Cubicks, and in all of them the known Quantities in the Equations were express'd only by numerical Letters, and there were no Symbols or Marks but for those that were unknown, or sought till *Vieta*, A. D. 1590, introduced Specious Arithmetick; that is, he denoted the known and unknown Quantities by Marks or Signs; whereby a very short and conspicuous Way of Notation was gain'd, and the whole Operation expos'd always to the Eye in a short Synopsis, and many Discoveries made in Algebra not taken notice of before.

Mr. Oughtred follow'd, and very much improv'd the Specious Arithmetick of *Vieta* in his *Clavis Mathematica*, first publish'd A. D. 1631, and invented many compendious Characters to express the Sums, Differences, Rectangles, Squares, Cubes, &c. of Quantities; as also did *Mr. Harriott*, who was Cotemporary with *Mr. Oughtred*, but died before him. He introduced the small Letters instead of the Ca-

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pitals used by *Vieta* and *Oughtred*, and first brought in the Sign of Equality now used among us, and wonderfully improved *Algebra* in several Respects, too many to be mention'd here.

There are many other ingenious Persons, both of the last Age and in this, who have endeavour'd to advance this Science, and carry it more and more towards its utmost Perfection, by daily augmenting it with new and curious Inventions.

ALGEBRA is divided into,

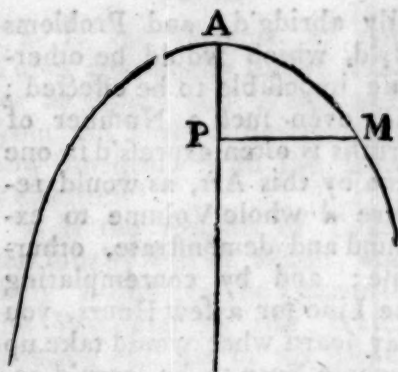
1. *Numeral*: Which was that of the Antients, and serv'd only to find the Solution of Arithmetical Problems, without any Demonstration; such as those given us by *Diaphantus*, &c.

2. *Specious*; sometimes call'd *Logistica Speciosa*; which is perform'd by Letters of the Alphabet, and is no ways limited, like the former *Algebra*, to any one certain Kind of Problems, but seems universally for the Investigation of Theorems.

ALGEBRAICK CURVE, in Geometry, is of such a Nature, that the Abscisses thereof bear always the same Proportion to their respective Ordinates; or (which is the same Thing) it is a Curve, wherein the Relation of the Abscisses to the Correspondent Ordinates can be expressed by an *Algebraick* Equation.

Thus if the Product of any Abscisse AP , x , multiply'd into the same Quantity p , be always equal to the Square of the Correspondent Ordinate PM^2 , yy . The Equation expressing the Nature of the Curve will be $px = yy$, and the Curve is the common Parabola, and

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because the two indeterminate Quantities AP , x , and PM , y , do denote straight Lines, the Curve is an *Algebraick* Curve. And it is plain, that there may be an infinite Number of such Curves, since there may be an infinite Number of Proportions between the Ordinates and Abscisses.

This will be a general Equation for all *Algebraick* Curves, viz. $ay^m + bx^n + cy^r d + df = 0$, where a , b , d , and f , are invariable Quantities, and x and y are the variable Abscisses and Correspondent Ordinates rais'd to Powers, whose Indexes are m , n , r , and s .

A general Expression for the Subtangent of all *Algebraick* Curves will be

$$\frac{may - rcyx}{nbx^{n-1} + scyx^{r-1}}$$

ALGENEB, a fix'd Star of the second Magnitude in the Right Side of *Perseus*, whose Longitude is $57^\circ 17'$, Latitude $30^\circ 5'$, and Right Ascension $44^\circ 15'$.

ALGOL, or *Medusa's-Head*, a fix'd Star of the third Magnitude in the Constellation *Perseus*, whose Longitude is $51^\circ 27'$, Latitude $22^\circ 22'$, and Right Ascension $42^\circ 23'$.

ALGO-

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ALGORITHM, sometimes call'd *Logistica Numeralis*, is the Sum of the principal Rules of Numeral Computation, that is, of Numeration, Addition, Subtraction, Multiplication, and Division.

ALGORISM, is the Practical Operation of the several Parts of specious Arithmetick, or Algebra; and sometimes the Word is used for the Practice of Common Arithmetick, by the ten Numeral Figures.

ALIDADA, an *Arabick* Word for the Label or Ruler, which is moveable about the Centre of an Astrolabe, Quadrant, &c. and carries the Sights.

ALIQUANT PART, is that which cannot measure any Number exactly, but that some Remainder will be at last, as 5 is an Aliquant Part of 12; for being taken twice it falls short, and when taken three times, it exceeds 12.

ALIQUOT PART of a Number, is such an one as will exactly measure it without a Remainder; as 3 is an Aliquot Part of 9, and 4 of 12, &c.

ALLIGATION, is a Rule in Arithmetick, (so call'd from the Numbers, being bound or connected together by Circular Lines,) relating to the Mixture of Merchandize; as Corn, Wine, Metals, Medicines, &c. one with another; and to the Proportions of the Ingredients in any Quantity, and the Price of such a Mixture. It is distinguish'd into two Kinds, viz. *Allegation Medial*, and *Alternate*.

ALLIGATION MEDIAL teaches how to find a Mean in the Price, Quantity, and Quality, between the Extreams; as if there are

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melted and mixed together two Kinds of Silver, one worth five Shillings, and the other worth four Shillings an Ounce, and there were three Ounces of the former, and six Ounces of the latter: To find the Value of an Ounce of the Mixture.

ALLIGATION ALTERNATE shews the due Proportion of every Ingredient entring the Mixture, and counter-changes the Places of such Excesses or Differences that fall out between the mean Price and the Extreams, ascribing it to the greater Extream which proceeds from the lesser, and contrariwise. As, suppose a Mixture of a hundred Quarts of Wine be required, that must be made up of these several Prices, 7 d. 8 d. 14 d. and 15 d. so as the Whole at last may be afforded at 12 d. a Quart.

ALLIOTH, a Star in the Tail of the *Great-Bear*, very much observ'd at Sea.

ALMACANTERS, an *Arabick* Word signifying the same as Parallels of Altitude, which see; some write it *Almicanterahs*, and others *Almacanterahs*.

ALMACANTERS STAFF, is an Instrument usually made of Pear-Tree, or Box, with an Arch only of 15 Degrees, to take Observations of the Sun about the Times of his Rising and Setting, in order to find the Amplitude, and so the Variation of the Compass.

ALMANACK, an *Arabick* Word for an Annual Book, wherein the Days of the Month, Eclipses, Lunations, Risings and Settings of the Sun, Stars, Festivals, &c. are set down.

ALTERNATE,

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ALTERNATE Proportion, or **Ratio**, is the assuming of Antecedent to Antecedent, as the Consequent to the Consequent; as if $A : B :: C : D$: then by Alternate Proportion will $A : C :: B : D$.

ALTERNATE ALLIGATION: See *Alligation Alternate*.

ALTERNATE ANGLES: See *Angle*.

ALTERNATION. This Word is used by several for the different Changes or Alterations of Order in any Number of Things proposed. This Alternation is easily found, by only multiplying continually all the Numbers, beginning at Unity: As, suppose it was required to know how many Changes can be rung upon five Bells. You need only write down 1, 2, 3, 4, 5, and then multiply all those Numbers continually one into another, and the last Product will be 120, the Number of Changes.

ALTIMETRY, the Art of Taking and Measuring of Heights, whether accessible or inaccessible.

ALTITUDE of a Figure, in Geometry, is the Distance from its Vertex to the Base, or it is a Perpendicular let fall from the Vertex to the Base.

ALTITUDE, or *Elevation of the Pole*, is the Quantity of an Arch of the Meridian intercepted between the Horizon and either of the Poles of the World.

ALTITUDE of the Equator, is an Arch of the Meridian intercepted between the Horizon and the Equator.

ALTITUDE of the Eye, in Perspective, is a Right Line let fall from the Eye perpendicular to the Geometrical Plane.

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ALTITUDE Meridian of the Sun, Star, or a Planet, is an Arch of the Meridian intercepted between the Horizon and the Centre of the Sun, Star, or Planet, when they are upon the Meridian.

ALTITUDE of the Nonagesime Degree, is the Complement to a Quadrant of the Distance of the Nonagesime Degree from the Vertex of any Place.

ALTITUDE of the Sun, Star, or a Planet, is an Arch of the Azimuth Circle, passing through the Centres of the Sun, Star, or Planet, contain'd between the Horizon and their Centres.

AMBIENT, encompassing round about. Thus the Bodies that happen to be placed round about any other Body are call'd *Ambient*, and often the *Circum-Ambient Bodies*; and the whole Body of the Air, because it encompasses all Things on the Face of the Earth, is call'd the *Ambient Air*.

AMBIGENAL HYPERBOLA, is an Hyperbola that has one of its infinite Legs inscrib'd in it, and the other circumscrib'd about it.

AMBIT of any Figure, in Geometry, is the Perimeter Circumference or Sum of all the Bounding or Encompassing Lines that includes it.

AMBLIGONIAL, in Geometry, signifies Obtuse-angular, or that the Sides of any plain Figure make an Obtuse Angle one with another. Thus an *Ambligonal Triangle* is such an one that has an Obtuse Angle.

AMPHYPROSTYLE, in Architecture, is a Kind of a Temple of the Antients, which had four Columns in the Front, and the same Number in the Face behind.

AMPHISCIL,

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AMPHISCII. The Inhabitants of the *Torid Zone* are thus call'd, in regard of their Shadows; because the Shadow of the Sun falls both Ways, *viz.* to the South, (as ours always do to the North,) when the Sun is beyond them in the Northern Signs, and to the North; when the Sun is to the Southward of them in Southern Signs.

AMPHYTHEATRE, is a spacious Building, either Round or Oval, having its *Arena*, or Pit, encompassed with a vast Number of Seats disposed in Rows, and rising gradually one over another. Its Use among the Antients was to exhibit Shews to the People; as the Combats of Gladiators, and of Wild Beasts. The Theatre of *Vespasian*, call'd the *Coliseum*, that at *Verona* in *Italy*, and that at *Nismis* in *Languedoc*, are the most celebrated that we have now remaining of Antiquity.

AMPLITUDE of the Sun, or Stars, is an Arch of the Horizon intercepted between the true East and West Points thereof, and the Centre of the Sun or Stars at their Rising or Setting, and so is either North and South, or Ortive and Occasive.

AMPITUDE (MAGNETICAL,) is an Arch of the Horizon, contain'd between the Sun at his Rising, and the East or West Point of the Compass; or it is the different Rising or Setting of the Sun from the East or West Points of the Compass; and is found by observing the Sun at his Rising or Setting by an Amplitude-Compass; and if the Compass had no Variation, the *Magnetical Amplitude* would be the same as the *True Amplitude*.

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ANABIBAZON. The Dragon's Head; or the Northern Node of the Moon, where she passes the Ecliptick from South to North, is sometimes called so.

ANACAMPTICKS signifies Reflecting; being frequently us'd in reference to Echoes, which are Sounds produc'd Anacamptically, or by Reflection; and therefore Anacampticks is by some taken for Catropticks.

ANACRONISM, an Error in Chronology, an undue Connection of Time, or a false Chronicling.

ANACLATICKS, a Part of Opticks which treats of all manner of Refractions, and is the same with Dioptricks.

ANALEMMA, an Orthographic Projection of the Sphere upon the Plane of the Meridian on a Plate of Brass, or Wood, with an Horizon and Cursor fitted to it. In this Projection the Eye is suppos'd to be at an infinite Distance in the Diameter of the Sphere passing through the East and West Points of the Horizon, and all the Circles of the Sphere will be projected into Straight Lines, or Ellipses. And if the Projection be large, most of the Problems in the Doctrine of the Sphere, may be easily and exactly performed by it.

ANALOGY, is the Comparison of several Ratio's together, and is the same as *Proportion*. Which see.

ANALYSIS. A Resolution of any Thing into its component Principals. For which reason Algebra is called the *Analytick Art* because it teaches us to solve Problems, and to demonstrate Theorems,
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by enquiring into the Bottom, Fundamental Constitution, and Nature of the Thing, which is, as it were, resolv'd into its Parts taken all to pieces, and then put together again, that so we may see into the Nature of it. And in this Sense, Analytical Demonstrations are contrary to Synthetical ones.

ANDROMEDA, a Northern Constellation, consisting of twenty seven Stars.

ANEMOSCOPE, a Machine invented to fore-shew the Change of the Air, or Wind. I have observ'd, that Hygrosopes made of Cate's-Gut, are very good Anemoscopes, and never fail hardly, by their turning the Index about, to foretell the shifting of the Wind. But as *Vitruvius* describes an Anemoscope, it shews, that the Antients rather designed it to shew which Way the Wind blew, than to foretell to what Quarter it would shift or change.

ANGLE (ACUTE,) is that which is less than a Right one; and is called Acute, because its Angular Point is sharp.

No Angle can contain full 180 Degrees; for the one Side falls into the same Straight Line as the other; and so they will both be one Straight Line, and cannot make an Angle.

ANGLE (ADJACENT,) is made by continuing out one Side of an Angle: Whence Adjacent Angles are contiguous, but not on the contrary.

ANGLE (CURV'D-LINE,) is the mutual Inclination of two Curves in the same Plane, meeting in one Point.

ANGLE (MIX'D-LINE,) is the mutual Inclination of a Curve and a Straight Line, both in the same Plane in one Point,

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ANGLE (OBTUSE), is that which is greater than a Right Angle, and is called Obtuse, because its Angular Point is blunt.

ANGLE (OBLIQUE), one either greater or less than a Right Angle.

ANGLE (PLANE), is the mutual Inclination of two Lines in a Plane meeting in one Point.

ANGLE (RIGHT), is when one Side of the Angle is perpendicular to the other, or it is such an one as is equal to that contiguous to it, and its Quantity is ninety Degrees.

ANGLE (RIGHT-LINED), is the mutual Inclination of two Right Lines meeting in one Point.

ANGLE (SOLID), is contained under more than two Planes, or Plane Angles, not being in the same Plane, and Meeting in a Point.

ANGLES (EQUAL SOLID), are such that are contained under Plane Angles, equal both in Multitude and Magnitude.

Because the Sum of all the Plane Angles that can be constituted about one Point, is no more than 360 Degrees. Therefore a Solid Angle cannot be made of Plane Angles, if their Sum is so much as 360 Degrees.

ANGLE (SPHERICAL), is the Inclination of the Planes of two great Circles of the Sphere.

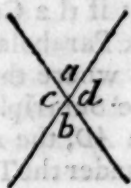
The Measure of a Spherical Angle, is the Arch of a great Circle at Right Angles, to the Planes of the great Circles forming the Angle, intercepted between them.

ANGLES (CONTIGUOUS), are such that have the same Vertex and one Common Side.

ANGLES

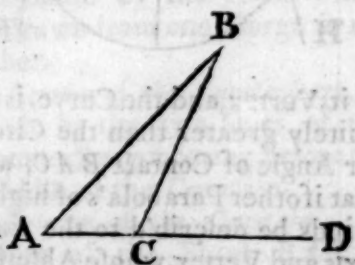
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ANGLES (VERTICAL or OPPOSITE), are those that are made by two Lines crossing one another, and which touch only in their Vertex, as the Angles



a and b are Opposite or Vertical Angles, as likewise c and d . These are always equal to one another.

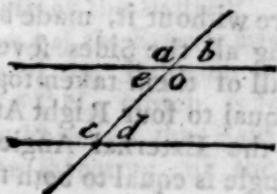
An Angle also in a Triangle, is said to be opposite to the Side that subtends it; as the Angle



A is opposite to the Side BC , the Angle C to the Side AB , and the Angle B to the Side AC .

In any Triangle, as ABC , the Angles B and A , are called *Internal* and *Opposite*, in respect of the External Angle BCD , which is equal to them both.

If a Line cuts two others that are parallel, the Angles c and d



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are called *Internal* and *Opposite*, in reference to the External ones a and b , to which they are respectively equal.

ANGLES (ALTERNATE). These are the Angles e and d , and c and b , which are respectively equal to one another.

ANGLE at the Periphery of a Circle, is an Angle whose Vertex and Legs terminate in the Periphery of a Circle.

ANGLE at the Centre of a Circle, is an Angle whose Vertex is at the Centre of a Circle, and whose Legs are two Radii's of the Circle.



It is demonstrated by *Euclid*, *Prop. 32. lib. 3.* that an Angle BAC at the Centre, is the Double of the Angle BDC at the Periphery, when they both stand upon the same Arch BC .

ANGLE in a Segment. An Angle is said to be in a Segment, when some Point is taken in the Circumference thereof, and from it Right Lines are drawn to the Ends of that Line which is the Base of the Segment: For the Angle contain'd under the Lines drawn, is said to be an Angle in a Segment, as the Angle EFG is said to be an Angle in the Segment EFG .

It is demonstrated by *Euclid*, *Prop. 31. lib. 3.* that all Angles in the same Segment are equal to one another, that is, any Angle EHG

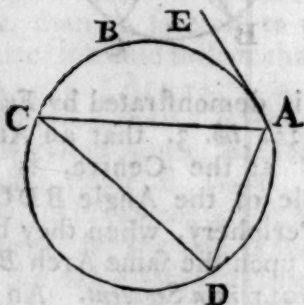
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$\angle EHG$ is equal to any Angle EFG , in the same Segment EFG .

ANGLE in a Semicircle, is an Angle in a Segment, whose Base is a Diameter of the Circle.

It is demonstrated by *Euclid*, *Prop. 1. lib. 3.* that an Angle in a Semicircle, is a Right one; in a Segment greater than a Semicircle less than a Right one, and in a Segment less than a Semicircle greater than a Right one.

ANGLE of a Segment, is that which is contain'd by a Right Line, and the Circumference of a Circle; or it is that which a Chord, or the Base of the Segment makes with a Tangent to the Circle in one End of that Chord; as the Angle CAE is the Angle of the Segment CAB .



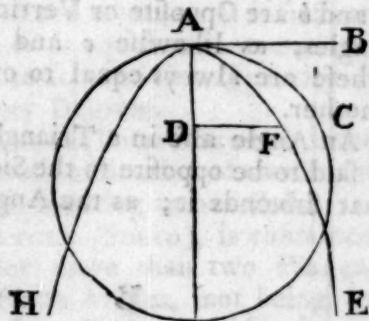
It is demonstrated by *Euclid*, in *Prop. 35. lib. 3.* that the Angle EAC is equal to any Angle; as ADC in the Alternate Segment CDA .

ANGLE of Contact, is that which a Circle, or other Curve, makes with a Tangent at the Point of Contact.

The Angle of Contact in a Circle is prov'd by *Euclid*, in *Prop. 16. lib. 3.* to be less than any Right-lin'd Angle. But

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from hence it does not follow, that the Angle of Contact is of no Quantity at all, as some have imagin'd: For Sir *Isaac Newton* says, in the *Scholium* of Page 32, *Princip. Mathem. Philo. Nat.* that if the Curve HAE be a Cubick Parabola, the Angle of Contact, where the Ordinate DF is in the Subtriple Ratio of the Abscisse AD , the Angle BAF contained under the Tangent AB



in its Vertex, and the Curve, is infinitely greater than the Circular Angle of Contact BAC ; and that if other Parabola's of higher Kinds be describ'd to the same Axis and Vertex, whose Abscisses AD are as the Ordinates DF^4 , DF^5 , DF^6 , &c. you will have a Series of Angles of Contact going on infinitely, of which any one is infinitely greater than that next before it.

ANGLE (OPTICK,) is that which is contain'd under Rays drawn from the extreme Points of an Object to the Center of the Pupil of the Eye.

ANGLES (EXTERNAL), are the Angles of any Right-lin'd Figure without it, made by producing all the Sides severally, and all of them taken together are equal to four Right Angles: And the External Angle of a Triangle is equal to both the Internal

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ternal and Opposite ones, as *Euclid* has demonstrated, *Lib. 1. Prop. 32.*

ANGLES (INTERNAL) are the Angles made by the Sides of any Right-lin'd Figure within.

The Sum of all the Internal Angles of any Right-lined Figure is equal to twice as many Right Angles as the Figure has Sides, excepting four. This is easily demonstrated from *Prop. 32. Lib. 1. Euclid.*

ANGLE of or at the Center, in Fortification, is the Angle CKE , which is made by the Concurrence of two straight Lines drawn from the Angles of the Figure FC .

ANGLE of the Circumference, in Fortification, is the mix'd Angle made by the Arch which is drawn from one Gorge to the other.

ANGLE of the Counterscarp, is made by the two Sides of the Counterscarp meeting before the Middle of the Courtain.

ANGLE of the *Courtain*, or Angle of the Flank *BAE*, is that which is made by, or contain'd between the *Courtain* and the Flank in any Piece of Fortification.

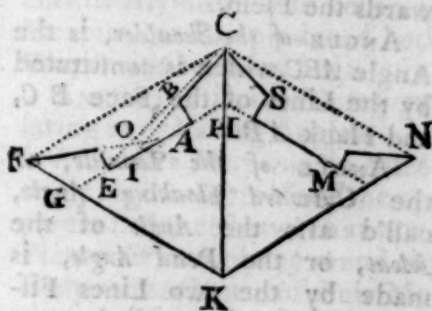
ANGLE of the Complement of the Line of Defence, is the Angle proceeding from the Intersection of the two Complements one with another.

ANGLE (DIMINISHED) is the Angle BCE , which is made by the Meeting of the outermost Sides of the Polygon, and the Face of the Bastion.

ANGLE of the Exterior Figure, or Angle of the Polygon, is the Angle FCN , which is form'd at the Point of the Bastion C , by the Meeting of the two

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outermost Sides or Bases of the Polygon FC and CN.



ANGLE of the Interior Figure, is the Angle $G H M$, which is made in H , the Centre of the Bastion, by the meeting of the innermost Sides of the Figure $G H$ and $H M$.

ANGLE FLANKING, is that which is made by the two Rasant Lines of Defence, viz. the two Faces of the Bastion prolonged.

ANGLE FLANKING *inward*, is the Angle CIH , made by the Flanking-Line and the Curtain.

ANGLE FLANK'D, by some called the *Angle of the Bastion*, is the Angle BCS , which is made by the two Faces BC, CS , being the utmost Part of the Bastion, most exposed to the Enemy's Batteries, and therefore by some is called the *Point of the Bastion*.

ANGLE *forming the Flank*, is that which consists of one Flank, and one *Demi-Gorge*.

ANGLE *forming the Face*, is that made of the Flank and Face.

ANGLE of the Moat, is that which is made before the Curtain, where it is intersected.

ANGLE *Re-entring, or Re-entrant Angle*, is that which retires inwards towards the Place.

ANGLE

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ANGLE SAILLANT, is that which advances its Point towards the Field.

ANGLE of the Shoulder, is the Angle ABC , which is constituted by the Lines of the Face BC , and Flank AB .

ANGLE of the Tenaille, or the *Outward Flanking Angle*, call'd also the *Angle of the Moat*, or the *Dead Angle*, is made by the two Lines Filichant in the Faces of the two Bastions, extended till they meet in an Angle towards the Curtain; and this is that which always carries its Point in towards the Work.

ANGLE of Elevation is that which the Line of Direction of a Projectile, makes with the Horizon.

ANGLE of Incidence, is that which the Line of Direction of a Striking Body, makes at the Point of Contact.

ANGLE of Reflexion, is that which is made by the Line of Direction, of a Body rebounding after it has struck against another Body, at the Point of Contact, from whence it rebounded.

The *Angle of Incidence and Reflexion* are always equal to each other, as is demonstrated in Dr. Kiel's *Introductio ad veram Physicam*.

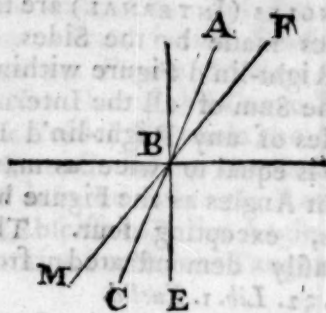
ANGLE of Elongation, or *Angle at the Earth*, is the Difference between the true Place of the Sun, and the Geocentrick Place of the Planer.

ANGLE of Commutation, is the Difference between the true Place of the Sun, seen from the Earth, and the Place of a Planer reduced to the Ecliptick.

ANGLE of Inclination in Opticks, is the Angle made by a Ray of

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Incidence, and the Axis of Incidence.



ANGLE of Refraction, is the Angle MBC , that a refracted Ray BC makes with the Ray of Incidence MB , continu'd out beyond the refracting Superficies. Angle refracted, is the Angle CBE , which the refracted Ray BC makes with the Axis of Refraction BE .

The *Ratio of the Sine of the Angle of Inclination to the Sine of the Refracted Angle*, is found to be constant, viz. if the Refraction be from Air to Glass, that is, greater than 114 to 76, but less than 115 to 76, that is, nearly as 3 to 2, as *Hugens* found by Experience in *Dioptr.* p. 5. Sir *Isaac Newton* in his *Opticks* says, it is as 31 to 20. But in all Glass the Quantity of Refraction is not quite the same.

Descartes says, in *Dioptr.* Lib. 1. Prop. 3. That he found the Ratio of the Sine of the Angle of Inclination to the Refracted Angle to be as 250 to 187, or as 4 to 3 nearly; and Sir *Isaac Newton* says, it is as 529 to 396, which is nearly the same.

Kircher (in *Arte magna lucis & umbræ*, lib. 8. part I. cap. 2.) and *Zaban*, (in *Oculo Artific. Fund.* 2. Synt. 1. cap. 2. f. 228, &c.) say, That if the Angle of Inclination

Inclination be 70 Degrees, the *Refracted Angle*, from Air to Glas, shall be $38^{\circ} 50'$. Upon which *Foundation Zaban* made the following *Table of Refraction*, from Air to Glas, which we have given contracted here.

Angles Inclin.	Refracted Angles.			Angles of Refraction.		
	o	'	"	o	'	"
1	0	40	5	0	19	55
2	1	20	6	0	39	54
3	2	0	3	0	59	56
4	2	40	5	1	19	55
5	3	20	3	1	39	57
6	3	59	50	2	0	10
7	4	39	48	2	20	12
8	5	19	49	2	40	11
9	5	59	35	3	0	25
10	6	39	16	3	20	44
11	7	18	55	3	41	5
12	7	58	32	4	1	28
13	8	38	2	4	21	58
14	9	17	25	4	42	35
15	9	56	46	5	3	14
16	10	35	59	5	24	1
17	11	15	3	5	44	57
18	11	54	5	6	5	55
19	12	34	36	6	25	24
20	13	11	34	6	48	25
25	16	22	51	8	37	9
30	19	29	29	10	30	31
35	22	30	18	12	29	42
40	45	24	6	14	35	54
45	28	9	19	16	50	41
50	30	44	35	19	15	25
60	35	13	12	24	41	48
70	38	50	0	31	10	0
80	41	5	15	38	54	55
90	41	51	40	48	8	20

ANGUINEAL HYPÉBOLA, is one of an Eel-like Figure, which cuts its Asymtote with contrary Flexions, and is produced both Ways with contrary Legs.

ANGULAR, is any Thing relating to or having Angles.

ANGULAR MOTION, in Astronomy, is the Increase of the apparent Distance between any two Planets, &c. revolving round any Body as the Centre of their Motion; and is express'd by two Right-Lines drawn from the said Centre to the revolving Bodies, which will open wider, and consequently grow greater, as the revolving Bodies part farther and farther from one another.

ANIMACULA, are very small Animals, such as by the Microscope have been discover'd in most Fluids, of which there are vast Numbers in Black-Pepper Water, as also in Water wherein Barley, Oats, and especially Wheat, has been steep'd for three or four Days.

ANIMATED NEEDLE, is one touch'd with a Load-Stone.

ANNUAL EQUATION. See *Equation*.

ANNUITY, is a yearly Rent to be paid for Term of Life, or Years, or in Fee.

ANNULET, in Architecture, is a narrow flat Molding, which is common to other Parts of a Column, the Bases, &c. as well as the Capital, and is the same Member which is sometimes called a Fillet, Listelle, Ceinture, Supercitium, Lift, Time, Square, Rabet.

ANOMALY, is the Distance of a Planet from the Aphelium, or Perihelium.

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ANOMALY, *Mean or Simple*, in the Old Astronomy, is the Distance of the mean Place of a Planet from the Apogæum; and in the New Astronomy it is the Time, that a Planet is moving



from the Aphelium A to the middle Place or Point I of its Orbit; and because the Area ASI , describ'd by a Ray drawn to the Planet in its Motion along the Arc AI , is proportional to the Time, as *Kepler* first discover'd, (see his *Comment* on the Motion of *Mars*;) and *Sir Isaac Newton* first demonstrated, (in his *Princip. Phys. Nat. Math.*) therefore this Area may very well represent the mean Anomaly. Or yet further, the Area SKA , found by drawing a Line LK thro' the Planet's Place perpendicular to the Line of the Apes PA , till it cuts the Circle AD , and drawing the Line SK , may represent the mean Anomaly; for this Area is every where proportional to the former Area SAI , as is demonstrated by *Dr. Gregory*, in *lib. 3. sect. 1. prop. 1. Elem. Astron. Physic. Math.*

ANOMALY of the Centre, in the *Ptolemaick* Theory of the Planets, is an Arch of the Zodiack terminated by the Line of the Apes; and by the Line of the mean Motion of the Centre; and in the New Astronomy, it is the Arch AK of an Excentrick Circle, be-

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tween the Aphelium A and a Right-Line KL , drawn from the Centre I of a Planet perpendicular to AP , the Line of the Apes.

ANOMALY, *True or Coequate*, is the Angle ASI at the Sun, which a Planet's Distance AI from the Aphelium appears under.

If the True Anomaly be given, the Mean one may easily be found; but it is very difficult to find the True Anomaly, when the Mean one is given. The Geometrical Methods of *Dr. Wallis*, and of *Sir Isaac Newton*, in *prop. 31. lib. 1. sect. 6. Princip. Phys. Math.* by the protracted Cycloid are not fit for Calculation; nor the Methods of Series, because they are too laborious; and therefore, Astronomers are forced to have Recourse to Approximation. And in order to solve this Problem, *Seth Ward*, in his *Astronomia Geometria*, takes the Angle ASI at the Focus, where the Sun is not for the Mean Anomaly, which will nearly represent it, if the Orbit of the Planet be not very Excentrick, and so very easily solves the Problem. But this Hypothesis of *Ward's* does not agree to the Orbit of *Mars*, which is more Excentrick than those of the other Planets, as *Ismael Bullialdus*, in the Defence of his *Philolaick Astronomy* against *Ward*, shews from four Observations made by *Tycho Brahe*. And so the Angle ASI at the upper Focus, ought to have a Correction first. This *Sir Isaac Newton* shews how to do, at the latter End of the Scholium of the above-mention'd *prop. 31*. And when this Correction is made, and the Problem solved according to *Ward's* Hypothesis, *Sir Isaac* says,

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that even in the Orbit of *Mars*, there will scarcely ever be an Error of above a Second. Whence this Method with Sir *Isaac's* Correction is preferable to any other, for finding the True or Coequated Anomaly from the Mean.

ANSES, or ANSÆ. Those Parts of the Ring of *Saturn* that are visible on each Side of the Planet, seen thro' a Telescope, when the Ring appears something open; so call'd, because they sometimes appear like Handles to the Body of the Planet.

In the Year 1668, August 17. at 11^m. 13^b. P.M. Mr. *Hugens* and Mr. *Picart*, by help of a 21 Foot Telescope, found the Inclination of the great Diameter of the Ring of *Saturn*, with the Equator, to be about 9 Degrees; whence they inferr'd, that the Angle of the Plane of the Ring with that of the Ecliptick must be about 31 Degrees.

ANTARES, the Scorpion's Heart, a fix'd Star of the first Magnitude in the Constellation *Scorpio*; its Longitude is 5° 41'. Latitude 4° 27'. and right Ascension 242° 54'.

ANTARTICK Pole, is the Southern Pole, or the End of the Earth's Axis, being so call'd, because it is opposite to the North Pole.

ANTARTICK Circle. See *Polar Circle*.

ANTECEDENTIA, or in Antecedentia. Astronomers say, a Planet is in *Antecedentia*, when it appears to move contrary to the usual Course or Order of the Signs of the *Zodiack*; as, when it moves from *Taurus* towards *Aries*; but if it goes from *Aries* to *Taurus*, &c. they say it goes in *consequentia*.

ANTECEDENT, is the former

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of two Terms of a *Ratio*, or that which is compared with the other: Thus, if the *Ratio* be as *A* to *B*, then *A* is said to be the *Antecedent*, or antecedent Term of the *Ratio*.

ANTÆ, or ANTES, in Architecture, are square Pillasters, which the Antients used to place at the Corners of the Walls of their Temples.

ANTICKS, in Architecture, are certain carved Works representing divers odd Shapes of Men, Beasts, Birds, Fishes, Flowers, &c. which being rudely determin'd, and form'd one out of another, serve as an Ornament to the whole Fabrick, and afford a grateful Variety to the Eye of the Beholder.

ANTIÆCI, are such Inhabitants of the Earth as dwell one against another in the same Semi-Circle of the same Meridian, and in the same Degree of Latitude, but one North, and the other South.

These have Noon and Midnight at the same time, but contrary Seasons of the Year, as when the Northern *Antiæci* have Summer, the Southern have Winter, &c. They live under the same Meridian, but in opposite Parallels.

ANTILOGARITHM. The Complement of the Logarithm of any Sine, Tangent, or Secant, to 90 Degrees.

ANTI-PARALLELS: See *Parallels*.

ANTIÆGMENTS, in Architecture, are the Ornaments or Garnishings, in carved Work, which are set on Architraves, whether of Wood or Stone.

ANTIPODES, are such Inhabitants of the Earth as live diametrically opposite to one another.

ther, that is, in Parallels of Latitude equally distant from the Equator, but one North, and the other South, and under the same Meridian, tho' 180, or just half of that Meridian distant from one another.

ANTIQUE. This Term is used to signify a Building, or Statue, made at the Time when the Arts were in their greatest Purity and Perfection among the antient *Greeks* and *Romans*. We likewise say the antique Manner, to signify any Thing done according to the strict Rules and good Taste of the Antients.

ANTISCHII, are such Inhabitants of the Earth, as live in two Places opposite to one another; one on the North, and the other on the South Side of the Equator; so that their Shadows at Noon fall different Ways, one directly opposite to the other.

APERITIONS, are the Openings in any Buildings; such as Doors, Windows, Stair-Cases, Chimneys, Outlets or Inlets for Light, Smoak, &c.

APERTURE, in some Writers of Geometry, (especially the *French*,) is the Inclination of one Right-Line to another, which meet in a Point, and form an Angle; and it is so call'd, because it is the Opening of the Legs of the Angle, like those of a Joint-Rule.

APERTURE, in Opticks, is the Hole next to the Object-Glass of a Telescope, or Microscope, thro' which the Image and Light of the Object comes into the Tube, and thence is carry'd to the Eye.

Mr. *Auzout* says, that he found

that the Apertures of Telescopes, ought to be nearly in the Subduplicate Proportion of their Lengths.

But Mr. *Hugens*, who was the first that found it convenient to use Apertures, says, in his *Dioptricks*, *prop.* 56. *p.* 205, & *seq.* that he found, by Experience, that the Aperture of an Object-Glass of 30 Foot is as 30 to 3, that is, as 10 is to 1, so is the Root of the Distance of the Focus of any Glass multiply'd by 30 to its Aperture, and that the focal Distances of the Eye-Glasses are proportional to the Apertures.

The greater or less Aperture of an Object-Glass does not increase or diminish the visible Area of an Object; all that is effected by this, is the Admittance of more or less Rays, and consequently the more bright or obscure Appearance of the Object. When you look at *Venus* thro' a Telescope, you must use a much less Aperture than for the Moon, *Jupiter*, or *Saturn*, because her Light is so vivid and glaring.

APHELIUM, or **AUGE**, is that Point of the Orbit of a Planet, wherein it is at the greatest Distance from the Sun.

The *Apheliums* of the primary Planets are at rest, as Sir *Isaac Newton* says, *prop.* 14. *lib.* 3. *Princip. Mathem.* But in the *Schellium* to the said Proposition, he says, the Planets nearest to the Sun, *viz.* *Mercury*, *Venus*, the *Earth*, and *Mars*, being acted upon by *Jupiter* and *Saturn*, their *Apheliums* move a small Matter in *Consequentia* with respect to the fix'd Stars, and that in the *Sesquiplicate Ratio* of the Distance

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Distance of those Planets from the Sun. So that if the *Aphelium* of Mars moves 35 Minutes in Consequentia, in respect of the fix'd Stars in 100 Years, the *Apheliums* of the *Earth*, *Venus*, and *Mercury*, will move in 100 Years 18 Min. 36 Sec. 11 Min. 27 Sec. and 4 Min. 29 Sec. respectively. In the *Philosophical Transactions*, N° 128. is a Geometrical Method of finding the *Aphelia* of the Planets by Dr. Halley.

Kepler places the *Aphelium* of Saturn for the Year 1700, in $28^{\circ} 3' 44''$. of *Sagittarius*.

(But De la Hire in $29^{\circ} 14' 41''$.) the *Aphelium* of Jupiter in $8^{\circ} 10' 40''$. of *Libra*.

(But De la Hire in $10^{\circ} 17' 14''$.) the *Aphelium* of Mars in $0^{\circ} 51' 29''$. of *Virgo*.

(But De la Hire in $0^{\circ} 35' 25''$.) the *Aphelium* of the *Earth* in $8^{\circ} 25' 30''$. of *Cancer*.

The *Aphelium* of Venus in $3^{\circ} 24' 27''$. of *Aquarius*, (but De la Hire in $6^{\circ} 56' 10''$.) And the *Aphelium* of Mercury, in $15^{\circ} 44' 29''$. of *Sagittarius*, (but De la Hire in $13^{\circ} 3' 14''$.)

The annual Motion (according to Kepler) of the *Aphelium* of Saturn is $1' 11''$. of Jupiter, $47''$. of Mars, $1' 7''$. of the *Earth* — of Venus $1' 18''$. and of Mercury $1' 45''$. But, according to De la Hire they are thus; of Saturn $1' 22''$. of Jupiter $1' 34''$. of Mars $1' 7''$. of the *Earth*, — of Venus $1' 26''$. and of Mercury $1' 39''$.

Apogæum, or Apogee, is that Point of the Orbit of a Planet or Comet, wherein it is nearest to the *Earth*.

Apogæe of the *Equant*, in the old Astronomy, is the farthest Distance of it from the *Earth*, or that Point where the Circum-

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ference of the *Equant* is intersected by the Line of the Apes in the remotest Part of the Diameter, as the *Perigee* of the *Equant* is the opposite Point of the nearest Part of the Diameter.

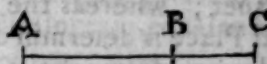
Mean Apogee of the *Epicicle*, is a Point where the *Epicicle* is cut above by a Right-Line drawn from its Center to the Center of the *Equant*, or the Point of the *Epicicle* most remote from the *Earth*.

Apomecetry, is the Art of measuring Things at a Distance, that is, how far they are off.

Apore, in Mathematicks, is a Problem, which tho' it be not impossible, yet it is very difficult to be resolved: As the finding the Longitude at Sea may be called an *Apore*, because it has not yet been discover'd.

Apophyge, in Architecture, is that Part of a Column, where it seems to fly out of its Base, like the Process of a Bone in a Man's Leg, and begins to shoot upwards, and is really no more than the Rings or Ferrils heretofore fasten'd at the Extremities of Wooden Pillars, to keep them from splitting, and afterward imitated in Stone-Work.

Apotome, is an irrational Remainder CB, when from a rational Line AC, a , you cut off



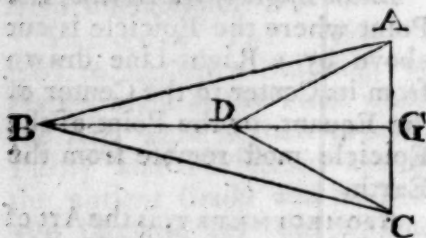
a rational Part AB, b , only commensurable in Power to the whole Line AC, and it may be express'd thus, $a - \sqrt{b}$.

Apotome, in Musick, is the Difference between a greater and a lesser Semi-Tone.

Apparent Magnitude of an Object, is the Quantity of the Optick

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Optick Angle. As the *Apparent Magnitude* of the Object AC , seen from D , is the Quantity of the Optick Angle ADC , and when seen from B , the Quantity of the Optick Angle ABC .



The *Apparent Magnitudes* of the same Object AC , seen at the Places D and B , that is, the Angles ADC and ABC are in a *Ratio* less than the reciprocal *Ratio* of the Distances DG , and BG ; but when the Object is very remote, *viz.* when the Optick Angles ADC , ABC , are not above one or two Degrees, they are nearly in that *Ratio* reciprocally.

APPARENT CONJUNCTION : See *Conjunction Apparent*.

APPARENT HORIZON : See *Horizon*.

APPARENT Place of a Planet, is a Point determin'd in the Superficies of the Sphere of the World, by a Line drawn from the Eye on the Surface of the Earth through the Centre of the Planet; whereas the True or Real Place is determin'd by a Line drawn from the Centre of the Earth to the Planet.

APPARENT Place of an Object, in Opticks, is that in which it appears, when seen through one or more Glasses, (or refracting Substances;) for since by Refraction through Glasses, (or other refracting Substances,) that Parcel of Rays that fall upon

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Pupil of the Eye, from each the Point of every near Object, is made to flow as close together as that which comes from a distant one: Or, since by the same Way, the Rays coming from distant Objects, are made to diverge as much as if they came from near ones, then the Eye must necessarily see the Place of the Object changed, which Change is its Apparent Place.

If an Object be nearer a Convex-Glass than its Focal Distance, its Apparent Place may be determin'd.

But if the Object be in the Focus of the Glass, the Apparent Place of the Object cannot be determin'd, only it will appear vastly remote. Neither can the Apparent Place be determin'd, if the Object be beyond the Focus of a Convex-Glass. But, if an Object be more distant from a Convex-Glass than its Focus, and the Eye be beyond the distinct Base, the Apparent Place of the Object will be in the distinct Base.

APPARENT Diameter of the Sun, Moon, or any Planet, is the Quantity of the Angle that their Diameters appear under, to an Observer on the Surface of the Earth.

The Apparent Diameter of the Sun, is now observ'd to be least when he is in *Cancer*, and greatest when in *Capricorn*. And in the Moon there is a two-fold Increase and Decrease of her Apparent Diameter; the one, when she is in the *Conjunction* and Opposition with the Sun, and the other in her *Quadratures*. The greatest Apparent Diameter of the Sun, according to Mr. *Cassini*, is $32' 10''$, and the

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the least $31' 38''$; and according to Mr. *De la Hire* the greatest is $32' 43''$, and the least $31' 38''$.

The greatest Apparent Diameter of the Moon, according to *Kepler* is $32' 44''$, and the least $30' 00''$; and according to Mr. *De la Hire*, the one is $33' 30''$, and the other $29' 30''$.

The greatest and least Apparent Diameters of the five Planets, according to *Hevelius*, are as in the following Table.

	Greatest.	Least.
♂	0' 19" 40'''	0' 14" 11'''
♂	0' 24" 12'''	0' 14" 36'''
♂	0' 20" 50'''	0' 2" 46'''
♀	1' 5" 58'''	0' 9" 34'''
♀	0' 11" 48'''	0' 4" 4'''

And the Apparent Diameter of *Saturn's* Ring, according to Mr. *Hugens*, is $1'. 18''$, when least.

If the Distances of any two very remote Objects (as for Example, the Planets) be equal, their true Diameters are proportional to the Apparent ones; and if the Apparent Diameters are equal, the True Diameters will be as the Distances from the Eye. Therefore, when neither the Distances nor the Apparent Diameters are equal, the True Diameters will be in a *Ratio* compounded of the direct *Ratio* of the Distances, and of the direct *Ratio* of the Apparent Diameters.

APPLICATE, is a Right-Line, otherwise called an *Ordinate* or *Semi-Ordinate*. Which see.

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APPLICATION, is sometime the Geometrical Term for Division; but Application also signifies the fitting or applying one Quantity to another, whose *Area's*, but not Figures, are the same. Thus *Euclid*, lib. 6. prop. 28. shews how to apply a Parallelogram to a Right-Line given, that shall be equal to a Right-lin'd Figure given.

APPLY. This Word is used three Ways.

1. It signifies to transfer a Line given into a Circle, (most usually,) or into any other Figure; so that its Ends shall be in the Perimeter of the Figure.

2. It is also used to express Division in Geometry, especially by the *Latin* Writers, who as they say *duc AB in CB*, (draw *AB* into *CB*,) when they would have *AB* multiply'd by *CB*, or (rather) have a Right-angled Parallelogram made of those Lines. So they say *applica AB ad CB*, (apply *AB* to *CB*,) when they would have *CB* divided by *AB*; which is thus express'd $\frac{CB}{AB}$.

3. It signifies also to fit Quantities, whose *Area's* are equal, but Figures different; as, when *Euclid*, in his sixth Book, shews how on a Line given to apply a Parallelogram, equal to a Right-lin'd Figure given.

APPROACHES, in Fortification, are Works cast up on both Sides; so call'd, because the Besiegers, by that Means, may draw near a Fortress without Fear of being discover'd by the Enemy. Or *Approaches* are all Sorts of Advantages, by the Help of which an Advancement

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may be made towards a Place besieg'd.

APPROXIMATION, in Arithmetick, or Algebra, is a continual Coming still nearer and nearer to the Root or Quantity sought, without expecting to have it exactly. There are several Methods of Approximation laid down by *Dr. Wallis*, *Mr. Ralphson*, *Dr. Halley*, *Howard &c.* and they are all nothing but a Series infinitely converging or approaching still nearer to the Quantity sought, according to the Nature of the Series.

If there be any Non-Quadrat or Non-Cubick Number, the former being express'd by $aa+b$, and the latter by $aaa+b$, where aa and aaa are the greatest Square and Cube in the proposed Numbers, then will

$$\sqrt{aa+b} = a + \frac{ab}{2aa+\frac{1}{2}b} \text{ and}$$

$$\sqrt[3]{aaa+b} = a + \frac{ab}{3aaa+\frac{1}{3}b} =$$

$$\frac{1}{2}a + \sqrt{\frac{1}{4}aa + \frac{b}{3a}}$$

These will be easy and expeditious Approximations to the Square and Cube Root.

APRON, is a Piece of Lead that raps over, or covers the Vent or Touch-Hole of a Piece of Ordnance.

APSIS, is used as well for the highest Part of an Orbit, to which when a Planet comes, it is at the greatest Distance from the Sun, as the lowest Part of that Orbit, when the Planet is in its nearest Distance to the Sun.

The Line of the *Apsis* or *Ap-sides*, is a Line drawn from the Aphelium to the Perihelium.

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AQUARIUS, a Constellation in the Heavens, being the eleventh Sign in the Zodiack, and is commonly mark'd with this Character ♒ , and consists of thirty three Stars.

AQUEDUCT, is a Conduit of Water, and signifies an artificial Canal, either running under Ground, or rais'd above it, and serving to convey Water from one Place to another, according to their Level, notwithstanding the Unevenness of the intermediate Ground. The *Romans* built several very considerable ones in their City: And *Julius Frontinus*, who had the Direction of them, tells us of nine which discharg'd themselves thro' 13 14 Pipes of an Inch Diameter; and *Blasius upon Livy* observes, that these Aqueducts brought into *Rome* above 500000 Hogsheds of Water in the Space of twenty four Hours.

AQUEOUS HUMOUR, or the watry Humour of the Eye, is the utmost being Transparent, and of no Colour; it fills up the Space that lies between the Cornea Tunicle and the ChrySTALLINE Humour.

AQUILA, or **VULTAR VOLANS**, a Constellation in the Northern Hemisphere; consisting of thirty two Stars.

ARA, the *Altar*, a Southern Constellation, containing eight Star.

ARACHNOIDES, is the ChrySTALLINE Tunic of the Eye; by some called also *Aranea Tunica*, or *ChrySTALLINA*, and is that which surrounds and contains the ChrySTALLINE Humour, by reason of its light thin Contexture, like that of the Web of

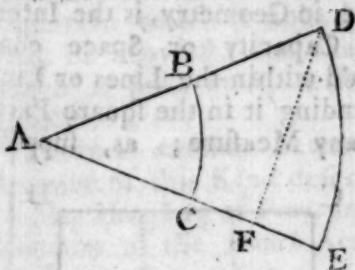
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a Spider. It has the Name of *Aranea*. This Coat, by Means of the Ciliary Processes, helps to move the Chrystalline Humour of the Eye nearer to, or further from, the Retina, and perhaps also to render its Figure more or less Convex.

ARCH, or ARC, in general is any Part of a Curve Line; but it is more usually taken for any Part of the Circumference of a Circle.

ARC's (EQUAL) of the same Circle, are such that contain the same Number of Degrees.

ARC's (SIMILAR;) if the Arc BC does contain the same Number of Degrees as the Arc DE; or if the Radius AB is to the Radius AD, as the Arc BC is to the Arc DE, then the Arc's BC and DE are similar.



If the Radius AD of any Arch DE be suppos'd 1, and the Sine DF thereof be call'd y , then the Length of the Arch DE will be express'd by this infinite Series:

$$y + \frac{1}{2 \times 3} y^3 + \frac{1 \times 3}{2 \times 4 \times 5} y^5 + \frac{1 \times 3 \times 5}{2 \times 4 \times 6 \times 7} y^7 + \frac{1 \times 3 \times 5 \times 7}{2 \times 4 \times 6 \times 8 \times 9} y^9 \text{ \&c.}$$

And if the first Term of this Series be called A, the second B, the third C, the fourth D, &c. and the second be multiply'd by $\frac{1}{2}$, the third by $\frac{1}{3}$, the

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fourth by $\frac{1}{4}$, &c. then that Series will become this:

$$y + \frac{1}{2 \times 3} A y^2 + \frac{3}{4 \times 5} B y^3 + \frac{5}{6 \times 7} C y^4 + \frac{7}{8 \times 9} D y^5 + \frac{9}{10 \times 11} \text{ \&c.}$$

The Distance of the Centre of Gravity of an Arc of a Circle from the Centre of the Circle, is a third Proportional to a third Part of the Periphery and the Radius.

ARCHES, in Architecture, are Part of the inward Support of any Superstructure, and they are either circular, elliptical, or streight, (as the Workmen improperly call it.)

ARCHES (ELLIPTICK,) were formerly much used instead of Mantletrees in Chimneys; They had a Key-Stone, and Chaptrrels, or Imposts, and consisted of two Haunses and a Scheme.

ARCHES (GOTHICK,) are such as are used in Gothick Buildings, call'd by the *Italians* *Di tarzo* & *di quarto acuto*, or of third and fourth Point, because they consist of two Arches of a Circle, meeting in an Angle at the Top, and drawn from the Division of a Chord into three, four, or more Parts, at Pleasure.

ARCH (SKEEN, or SCHEME,) is a flat Arch, less than a semicircular one.

ARCHES (STREIGHT,) as the Workmen improperly call them, which are used over Windows and Doors, &c. have plain steright Edges both upper and under, which are parallel, but both the Ends and Joints do all point towards a certain Centre. They are now usually about a Brick and

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and a half thick; which, when rubb'd, is about twelve Inches. The levelling End of this Arch is called the Skew-Back; and the several Joints between the Courses of Bricks in the Arch, the Workmen call the Sommering.

ARCHIPALAGUS, in Geography, is a Part of the Sea; containing many small Islands one near another, and consequently many little Seas denominated from those Islands; as, the *Grecian Archipelago*, or *Ægean Sea*.

ARCHITECT, is one that understands Architecture, which is the Art or Science of well Building, that is, of conceiving an Idea of an Edifice in the Mind, and building it according to the same, so as to answer the End of the Builder; and is divided into Civil, Military, and Naval.

ARCHITECTURE (CIVIL,) teaches how to make any Kinds of Buildings; as Palaces, Churches, or private Houses.

ARCHITECTURE (MILITARY,) instructs us in the best Ways of fortifying Cities, Camps, Sea-Ports, or any other Places of Strength. And,

ARCHITECTURE (NAVAL,) is the Building of Ships.

ARCHITRAVE is the principal Beam, or Poitrail in any Building, and the first Member of the Entablement, being that which bears upon the Column, and is made sometimes of a single Summer, as appears in most of the antient Buildings, and sometimes of several Haunses, as is usual in the Works of the Moderns. It is call'd the *Reason-Piece*, or *Master-Beam*, in Timber Buildings; but in

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Chimneys it is called the *Mantlepiece*; and over the Jaumbs of Doors, and Lintels of Windows, *Hyperthyron*.

ARTICK CIRCLE, is a lesser Circle of the Sphere, or Globe, parallel to the Equator, and $23^{\circ} 30'$ from the North Pole of the World, from whence it takes its Name. This, and the Antartick Circle, which is one parallel to the Equator, and at the same Distance from the South Pole, are call'd the two Polar Circles.

ARCTOPHYLAX. See *Bootes*.

ARCTURUS: A Fix'd Star of the first Magnitude, placed in the Skirt of *Arctophylax*. Its Longitude is 199 Degrees, 39 Minutes, Latitude 31 Degrees, 2 Minutes, and Right Ascension 210 Degrees, and 13 Minutes.

AREA, of any superficial Figure, in Geometry, is the Internal Capacity or Space contain'd within the Lines or Line bounding it in the square Parts of any Measure; as, suppose



the Side *AB* of the Parallelogram *ABCD* to be three Inches, or three Foot, or three Yards, &c. and the Side *AC* to be four Inches, or four Foot, or four Yards, &c. then the Area or superficial

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superficial Capacity of the said Parallelogram will be twelve Inches, or twelve Foot, or twelve Yards, or will contain twelve little equal Squares, each of whose Sides is one Inch, or one Foot, or one Yard.

For the Area's of Figures, see under their respective Names.

AREOMETER, is an Instrument to measure the Gravity of Liquors; and it is usually made of a thin fine Glass Ball, with a long taper Neck, seal'd at the Top, there being first as much running Mercury put into it as will serve to keep it swimming in an exact Posture. The Stem, or Neck, is divided into Parts, which are number'd, that so by the Depth of its Descent into any Liquor, its Lightness may be known by those Divisions; for that Fluid or Liquor in which it sinks least, must be heaviest, and that in which it sinks most, will be lightest.

There is another newer Instrument of this Kind describ'd by Mr. *Hornberg* of *Paris* in the *Memoirs* of the *French Academy* for the Year 1699.

AREOSTYLE, in Architecture, is a Sort of Edifice where the Pillars are set at a great Distance from one another.

ARGO NAVIS, a Southern Constellation, consisting of forty two Stars.

ARGUMENT of Inclination, is an Arc of an Orbit, intercepted between the Node ascending, and the Place of the Planet from the Sun, being number'd according to the Succession of Signs.

ARGUMENT of the Moon's Latitude, is her Distance from the Node.

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ARIES, a Constellation of Stars drawn on the Globe in the Figure of a Ram. It is the first of the twelve Signs of the Zodiac, and mark'd thus γ , and consists of nineteen Stars.

ARITHMETICK, is the Art or Science of Numbers.

ARITHMETICK (BINARY,) is that wherein only Unity, or 1 and 0 are used. This was devis'd by Mr. *Lebnitzs*, (see *Miscellaneis Berolen.* p. 336. & seq.) who shews it to be apt for discovering the Properties of Numbers; and Mr. *Dangicourt*, in the *History of the Royal Academy of Sciences for the Year 1703.* p. 105. gives us a Specimen thereof about Arithmetical Progressions; where he shews, that because in Binary Arithmetick only two Characters are used, therefore the Laws of Progression may be the easiest of all discover'd by it.

ARITHMETICK (COMMON.) This signifies the practical Rules of Addition, Substraction, Multiplication, Division, &c. of Numbers, and Decimal Fractions.

ARITHMETICK (DECADAL,) is the Arithmetick which we use by the nine Figures and a Cypher, which is commonly attributed to be the Invention of the *Arabians*, and was, no doubt, taken from the Number of our Fingers, which is ten; because, in Computations, we use the Fingers before we understand Arithmetick.

ARITHMETICK (DECIMAL,) is the Doctrine of decimal Fractions.

ARITHMETICK (INSTRUMENTAL,) is the Performance of the Rules of Common Arithmetick by Instruments.

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ARITHMETICK (LOGARITHMETICAL,) is the Doctrine of Logarithms.

ARITHMETICK (POLITICAL,) is the Application of Arithmetick to Politicks.

ARITHMETICK (PRACTICAL,) is the Art of Computation, that is, from some given Numbers it teaches how to find others, whose Relation to the known ones is given; as, if a Number was to be found that is equal to the given Numbers 6 and 8 taken together.

ARITHMETICK (SEXAGESIMAL,) is the Doctrine of Sexagesimal Fractions.

ARITHMETICK (SPECIOUS,) is the same as Algebra.

ARITHMETICK (TETRACTICAL,) is that wherein only 1, 2, 3, and 4 are used.

There is a Treatise of this Arithmetick written by Mr. *Echard Weigel*, a German; but both Binary Arithmetick and this are useless Curiosities, especially with regard to the practical Part, since the Decadal Arithmetick is receiv'd by all Nations, and ingrafted in us while Children, and since the Trouble of learning a new Numeration will not be ballanc'd by the Advantage gain'd from it; and lastly, because Numbers may be vastly more compendiously express'd by Decadal Arithmetick, than by either of these.

ARITHMETICK (THEORETICAL,) is the Knowledge or Science of the Properties of Numbers.

ARITHMETICK of Infinities, is the Method of summing up a Series, or Row of Numbers, consisting of infinite Terms,

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or of finding the Ratio's of them.

This Method was first invented by Dr. *Wallis*, as may be seen in his *Opera Mathematica*, Vol. 1. where he shews the Use of it in Geometry, in finding the Area's of Superficies, and the Contents of Solids, and their Proportions. But the Method of Fluxions, which is a universal Arithmetick of Infinites, performs these Things much easier, and a Multitude of Things can be perform'd by the latter, that the former will not touch.

ARITHMETICAL COMPLEMENT of a Logarithm, is what that Logarithm wants of 10.000000; as the Arithmetical Complement of the Logarithm 8154032 is 1.845968; where every Figure, but the last 8, is taken from 9, and that from 10.

ARITHMETICAL PROPORTION, or PROGRESSION, is when Numbers, or other Quantities, do proceed by equal Differences, either increasing or decreasing; as 2, 4, 6, 8, 10, &c. or a , $2a$, $4a$, $6a$, &c. or 5, 4, 3, 2, 1, or $5a$, $4a$, $3a$, $2a$, a ; where the two former Series are increasing, and the two latter decreasing, the common Difference in those being 2, and in these 1. Here follows some Properties of Arithmetical Progressionals.

1. If there are three Quantities in Arithmetical Progression, the Sum of the Extrems is equal to the Double of the Means; as 2, 4, 6, are so; whence $2+6=2\times 4$.

2. If there be four Quantities in Continual Arithmetical Pro-

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Proportion, the Sum of the Extreams is equal to the Sum of the Means; as 2, 4, 6, 8 are so; whence $2+8=4+6$.

3. If never so many Quantities are in an Arithmetical Progression, the Sum of the Extreams is always equal to the Sum of any two Means equally distant from the Extreams, or to the Double of the middle Term, if the Number of Terms be odd; as suppose 2, 4, 6, 8, 10, 12, be an even Number of Terms, then $2+12=4+10=6+8$; and if 2, 4, 6, 8, 10, be an odd Number, then $2+10=2 \times 6$.

4. The Sum of any Number of Terms of an Arithmetical Progression, is equal to the Sum of the Extreams multiplied by half the Number of Terms, or half that Sum multiplied by the whole Number of Terms; as the Sum of all the Terms in the last Progression is $=2+10$

$$\times 2\frac{1}{2} \text{ or } = 5 \times \frac{2+10}{2}$$

5. The Ratio of the Sum of an Arithmetical Progression, whether finite or infinite, whose first Term is 0, is to the Sum of as many Terms equal to the greatest; as 1 to 2.

6. The Ratio of the Sum of the Squares of every Term of an Arithmetical Progression, beginning at 0, and continued to Infinity, is as 1 to 3.

7. The Ratio of the Sum of the Cubes of such a Progression, is to the Sum of as many Terms equal to the greatest; as 1 to 4.

8. And universally, if m be the Power that every Term of such a Progression is raised to, the Sum of all them Powers will be to as many Terms equal to the greatest; as 1 to $m+1$.

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All these Theorems, but the last, are demonstrated by *Sturmy*, in his *Mathesis Enucleata*.

ARITHMETICAL INSTRUMENTS, are Instruments to perform Arithmetical Operations with; such as Naper's Bones, and Sliding Rules, &c.

ARITHMETICAL MEAN, is the middle Term of three Quantities in Arithmetical Progression.

ARK, the same as Arch. Which see.

ARK of Direction, or Progression, in Astronomy, is that Arch of the Zodiack that a Planet appears to describe, when its Motion is progressive according to the Order of the Signs.

In the Ptolemaick System, it is the Arc of the Epicycle, which a Planet describes when it is progressive according to the Order of the Signs.

ARK of Retrogradation, is that which a Planet describes when it is retrograde, or moves contrary to the Order of the Signs.

ARK of the first and second Station, is the Arc that a Planet describes in the former or latter Semi-circumference of its Epicycle, when it appears stationary.

ARM'D. A Loadstone is said to be Armed, when it is capp'd, cased, or set in Iron or Steel, in order to make it take up a greater Weight, and also to distinguish its Poles readily.

The Armour of a Loadstone, in Figure of a Right-angled Parallelopipedon, consists of two thin Pieces of Steel or Iron, in Figure of a Square, having a Thickness proportional to the Goodness of the Stone; for if a weak Stone has a strong Armour,

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mour, it will produce no Effect; and if the Armour of a strong Loadstone be too thin, it will not produce such an Effect as when thicker: A convenient Thickness for the Armour is found by filing it thinner and thinner, until you find its Effect to be the greatest possible. The Armour of a Spherical Loadstone consists of two Steel Shells fasten'd to one another by a Joint, and must cover a good Part of the Convexity of the Stone. This must be also filed away by Degrees, until the Effect of the Loadstone is found to be the greatest possible.

It is very wonderful that the Armour of a Loadstone will so much augment its Effect, that good Stones after they are arm'd, will lift up above 150 Times more than before.

There are indifferent good Loadstones, which when unarmed weigh about three Ounces; but when arm'd, will lift up more than seven Pounds.

ARMILLARY SPHERE, is when the greater and lesser Circles of the Sphere, being made of Brass, Wood, Pastboard, &c. are put together in their natural Order, and plac'd in a Frame, so as to represent the true Position and Motion of those Circles.

ARTIFICIAL DAY, being the same as the Natural Day, is that Space of Time elapsed from the Rising of the Sun to the Setting thereof; whence the Length of the Artificial Day, of those inhabiting under the Equinoctial will always be twelve Hours; and to those that are nearer the Poles, the Ar-

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tificial Day is so much the longer; so that the Length of the Artificial Day to those under the Poles, (if there be any People there,) will be half a Year.

ARTIFICIAL Numbers, Sines, and Tangents, are the Logarithms of the Natural Numbers, Sines, and Tangents.

ASCENDING NODE, is that Point from whence a Planet runs Northward beyond the Ecliptick.

ASCENSIONAL DIFFERENCE, is the Difference between the Right and Oblique Ascension of any Point in the Heavens; or it is the Space of Time the Sun rises or sets before or after six a-Clock; as Co-T. Lat. : T. ☉ Decl. :: R : S. of Ascensional Difference.

ASCENSION (OBLIQUE,) is that Degree and Minute of the Equinoctial, reckoning from the Beginning of *Aries*, which rises with the Center of the Sun, or a Star, or which comes to the Horizon at the same Time as the Sun, or a Star, in an Oblique Sphere.

ASCENSION (RIGHT) of the Sun, or a Star, is that Degree of the Equinoctial, accounted from the Beginning of *Aries*, which rises with it in a Right Sphere. R : Co-S. ☉'s greatest Decl. :: T. Dist. from γ or α : T. Right Ascension.

ASCII are the Inhabitants of the Torrid-Zone, which twice a Year have the Sun (at Noon) in their Zenith, and consequently then their Bodies cast no Shadow. Whence comes the Name of *Ascii*.

ASPECT, is the Situation of the Planets and Stars, in respect of

of one another. Of these they commonly reckon five different Sorts.

1. **SEXTILE**, is when two Planets, or Stars, are sixty Degrees from one another.

2. **QUARTILE**, when they are ninety Degrees distant from one another.

3. **TRINE**, when they are distant 120 Degrees.

4. **OPPOSITION**, when they are 180 distant.

5. **CONJUNCTION**, when they are both in the same Degree.

Kepler added eight new Aspects to these, viz. the Demi-sextile of 30° , the Decile of 36° , the Octile of 45° , the Quintile of 72° , the Tredecile of 108° , the Sesquartile of 135° , the Biquintile of 144° , and the Quincunx of 150° .

All these different Positions of the Planets are reckon'd in the Ecliptick by the secondary Circles drawn thro' the Centres of the Planets, that is, if the secondary Circles, drawn thro' the Centres of two Planets, cut the Ecliptick in two Points, that are sixty Degrees distant from one another, then those Planets are said to be in a Sextile Aspect. Understand the same in others.

ASTERISM. The same with *Constellation*, or a Collection of many Stars into one Class, or System, which is usually on the Globe represented by some one particular Image, or Figure, to distinguish the Stars that compose this Constellation from those of others.

ASTRAGAL from *Astragalos*, in Greek, *the Bone of the Heel*, is a little round Moulding, which encompasses the Top of the first, or Shaft of a Column, and dif-

fers from the Torus only in Bigness, its Height being $1\frac{1}{2}$ Module, and 3 Min.

ASTROLABE. The Name of a plain Sphere, or Stereographick Projection of the Sphere, either upon the Plane of the Equinoctial, the Eye being supposed in the Pole of the World, or upon the Plane of the Meridian, when the Eye is supposed in the Point of Intersection of the Equinoctial and Horizon. *Stoffler*, *Gemma Frisius*, and *Clavius* have treated of this Projection.

ASTROLABE (SEA), is an Instrument for taking the Altitude of the Sun, or Stars, at Sea; being a large Brass Ring of about 15 Inches in Diameter, whose Limb, or a convenient Part thereof, is divided into Degrees and Minutes, with a moveable Index or Label, which turns upon the Centre, and carries two Sights. At the Zenith is a Ring, to hang it by in Time of Observation, when you need only turn it so to the Sun, that the Rays may pass freely thro' both the Sights, and the Edge of the Label cuts the Altitude in the Limb. This Instrument, if well made, (tho' not now much in use,) is as good, if not better than any of the other Instruments that are used for taking the Altitude at Sea; especially for taking of Altitudes between the Tropicks, when the Sun comes near to the Zenith.

ASTROLOGY, is an Art that pretends to foretel future Things from the Motion of the heavenly Bodies, and their Aspects to one another, and from imaginary Qualities that are supposed to be in the Planets and Stars affecting Mortals here below.

below. But as there is nothing of Truth in this Art, as all deserving People in this Age are very well satisfy'd of, therefore it will be to little or no Purpose to explain the Terms of it.

ASTRONOMICAL KALENDAR, is an Instrument engraved upon Copper-Plates, printed on Paper, and pasted on Board, with a Brass Slider, which carries a Hair, and shews, by Inspection, the Sun's Meridian, Altitude, Right Ascension, Declination, Rising, Setting, Amplitude, &c. to a greater Exactness than our common Globes will shew.

ASTRONOMICAL HOURS, are the equal Hours. Whereof there are 24 accounted from the Noon of one natural Day, (or, as some will have it, from Midnight) to the Noon or Midnight of the next natural Day.

ASTRONOMICAL QUADRANT, is a large Quadrant made all of Brass, or of Wooden Bars usually faced with Plates of Iron, having its Limb divided into Degrees and Minutes, and even Seconds, if possible, with plain Sights fix'd to one Side of it, or instead thereof a Telescope, and an Index moving about the Centre, carrying either plain Sights, or a Telescope.

These Quadrants are us'd in taking Observations of the Sun, Planets, or fix'd Stars. The Antients us'd only plain Sights; but the Moderns have found it of vast Benefit to use Telescopes instead of them. And the Contrivance well known to our Instrument-Makers, of moving the Index, by Help of a Screw on the Edge of the Limb, and of readily and easily directing it, and

the Quadrant upon its Pedestal, to any desir'd Phænomena by Means of Screws and dented Wheels, is a still greater Improvement of this Instrument.

Tycho Brahe was the first that us'd a tolerable *Apparatus* of Astronomical Instruments, which are describ'd in his *Astronomia Instaurata Mechanica*, printed in the Year 1602. But *Hevelius's Apparatus*, describ'd in his *Machina Cœlestis*, A. D. 1673. are abundantly more sumptuous, and better contriv'd than *Tycho Brahe's*. Yet these, one should think, could not perform Observations so exact, as if he had us'd Telescopick Sights; for he would not use them. And that occasion'd Dr. *Hooke* to write *Animadversions upon Hevelius's Instruments*, printed in the Year 1674, wherein he despises them on Account of their Inaccuracy. But Dr. *Halley*, with the Consent of the *Royal Society*, went over to *Dantzick* in the Year 1679, to inspect his Instruments, and did approve of the Accuracy of them, and of his Observations with them.

ASTRONOMY, is the Science or Knowledge of the Universe, and the Phænomena thereof.

ASTRONOMY (SPHERICAL), is the Consideration of the Universe, as it offers itself to our Sight.

ASTRONOMY (THEORETICAL) is the Consideration of the true Structure of the Universe; and from thence the Determination of the Appearances thereof.

Astronomy, is very antient, as we may learn from *Porphyrio*, who says, That when *Alexander the Great* took *Babylon*, *Callisthenes*, at the Desire of *Aristotle*, carry'd from thence to *Greece* Observations

tions of nearly 2000 Years, and we learn from *Ptolemy*, that *Tymocaris*, and *Aristyllus* left several Observations of the Fix'd Stars about 120 Years before Christ.

But the Astronomy of the Antients was very defective upon Account of their bad Instruments, and their Want of the Knowledge of the Telescope, and the Use of the Micrometer, and the false System of the World that they so strenuously adhered to, till *Copernicus* having revived the true *Pythagorean* System about the Year 1556, in *Libro de Revolutione Caelestium*, and afterwards *Kepler*, from the Observations of *Tycho Brahe*, (in his *Comment on the Motions of Mars*, printed in the Year 1609,) having found out the Laws of the Motions of the Planets, Astronomy then began to gain ground, and shine in its true Lustre; and at length, by the Labours of several ingenious Persons, (most our own Countrymen,) especially *Sir Isaac Newton*, it is now arrived, perhaps, to the greatest Perfection that Mortals will be ever able to bring it to.

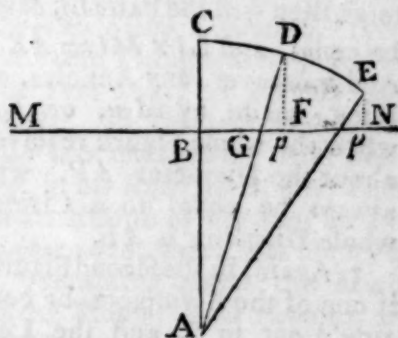
ASYMPTOTES, are properly Straight Lines, that approach nearer and nearer to the Curve they are said to be the Asymptotes of; but if they, and their Curve, are indefinitely continued, they will never meet. Or Asymptotes are Tangents to their Curves at an infinite Distance. And two Curves are said also to be Asymptotical, when they continually approach to one another; and if indefinitely continu'd, do not meet. As two Parabola's, that have their Axis

placed in the same straight Line, are Asymptotical to one another.

Of Curves of the second Kind, that is, the Conick Sections, only the Hyperbola has Asymptotes, being two in Number.

All Curves of the third Kind have at least one Asymptote; but they may have three: And all Curves of the fourth Kind may have four Asymptotes. The Conchoid, Cissoid, and Logarithmick Curve have each one Asymptote.

The Nature of an Asymptote will be very easily conceiv'd from that of the Conchoid: For if *CDE* be a Part of the Curve of the Conchoid, and *A* its Pole, and the Right Line *MN* be so drawn, that the Parts *BC*, *GD*, *FE*, &c. of Right Lines, drawn



from the Pole *A*, be equal to each other, then the Line *MN* will be the Asymptote of the Curve, because the Perpendicular *Dp* is shorter than *BC*, and *EP* than *Dp*, and so on; and the Points *E*, &c. and *p* can never coincide.

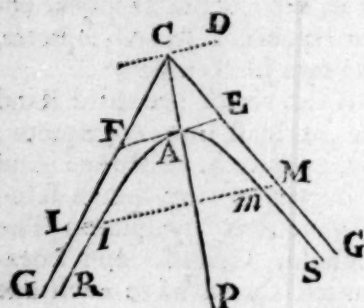
1. If *CP* be a Diameter of the Hyperbola *RAS*, and *CD* be the Semi-conjugate to it; and if the Line *FE* be a Tangent in the Point *A*, and *AE = FA = CD*; then,

D

then,

A S

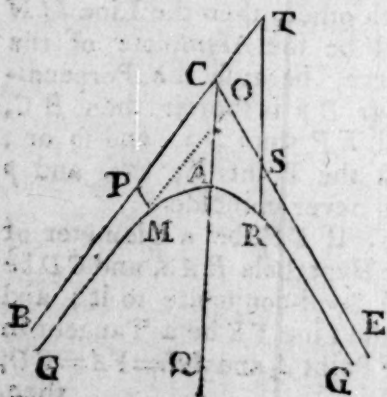
then, if the Lines CG, CG , be drawn from the Center C thro'



the Points E and F , these Lines CG, CG , will be the Asymptotes of the Hyperbola RAS . And,

2. If any Right Line LM be drawn parallel to the Tangent FE , (or even not parallel) to cut the Curve and the Asymptotes, then will the Parts LI, Mm , be equal, and $LI \times MI = AE^2$. And moreover, any Annulus, or Ring, made by Mm , or LI , when the whole Figure revolves about the Diameter AP , will always be equal to a Circle, whose Diameter is AE .

3. Again, in the second Figure, if one of the Asymptotes be continu'd out to T , and the Line TSR be drawn parallel to the



A S

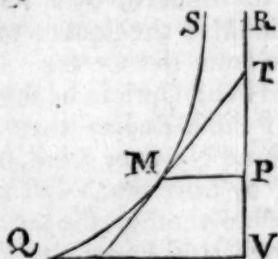
Diameter CQ , then $TR \times SR = AC^2$; and if the Line PM be any where drawn parallel to the Asymptote CS , then $CP \times PM$ will be always the same, that is, always a standing Quantity.

4. If the Hyperbola GMR be of any Kind, whose Nature, with Regard to the Curve and its Asymptote, is express'd by this general Equation $x^m y^n =$

a^{m+n} , and the Right Line PM be drawn any where parallel to the Asymptote CS , and the Parallelogram $PCOM$ be completed, then this Parallelogram is to the Hyperbolic Space $PMGB$, contain'd under the determinate Line PM , the Curve of the Hyperbola GM indefinitely continu'd towards G , and the Part PB of the Asymptote indefinitely continu'd the same Way, as $m-n$ is to n ; and so if m be greater than n , the said Space is squarable; but when $m=n$, as it will be in the common Hyperbola, the Ratio of the foregoing Parallelogram to that Space is as 0 to 1, that is, the said Space is infinitely greater than the Parallelogram, and so cannot be had; and when m is less than n , then that Parallelogram will be to that Space, as a negative Number to a positive one, and the said Space is squarable; and the Solid, generated by revolving the indeterminate Space GMO about the Asymptote CE , is the Double of the Cylinder, generated by the Motion of the Parallelogram $PCOM$ about the Axis CO .

5. If MS be the Logarithmick Curve, and PR an Asymptote, and PT the Subtangent, and MP an Ordinate, then

then will the indeterminate Space $RPMS = PM \times PT$; and the Solid, generated by the Rotation of this Curve about the Asymptote VP , will be $\frac{1}{2}$ of a Cylinder, whose Altitude is equal to the Length of the Subtangent, and Semidiameter of the Base equal to the Ordinate QV .



ATMOSPHERE, is all the Air, that the Earth is encompass'd with, consider'd together.

A very sensible Effect of the Pressure of the Atmosphere is shewn, by drawing the Air out of two equal Brass Segments of a Sphere, whose Brims are well polished, of about three Inches in Diameter; for when the Air is drawn out of them after they are apply'd to each other, it will require a Weight of about 140 Pounds to pull them asunder.

That the Moon has an Atmosphere, may be gather'd from several Observations made by Astronomers.

1. Mr. Wolf, in the *Acta Eruditorum*, for the Year 1706, p. 385. says, That at the Time of the great Eclipse of the Sun, May the 1st, 1706, he observed a Lucid Ring about the Moon, parallel to her Limb, which he could very well perceive not to be a Lucid Part of the Sun; for the Sun's Splendor not only by far exceeded the Silver Splendor of the Ring,

but likewise the Lucid small Part of the Sun did not terminate in the same Periphery as the Ring; and the Ring appear'd more dense on the obverse Side of the Moon, than on the contrary Side, yet notwithstanding it terminated in the same Periphery. And this Ring was observed by several others, as may be seen in the *History of the Academy Royal of Sciences*, for the Year 1706.

2. Mr. De Tschirnhausen, at Dresden, with a Telescope of 16 Foot long, a little before the Beginning of the aforelaid Eclipse, did observe a Trembling in that Limb of the Sun that the Moon first obscur'd; as he did likewise in the last Digit, at the Instant of the Obscuration. Moreover, Kepler, in his Book *De Novo Stella Serpentarii*, says, the same Thing was observed in the Year 1605, at Antwerp and Naples, in October, when the Sun was totally hid. And Scheiner, in his *Rosa Ursina*, says, That in an Eclipse of the Sun, in December 1628, there was observ'd a Trembling about the Limb of the Moon: And Hevelius, in his *Cometography*, says, in some Eclipses the same Phænomena presented it self to him.

3. Mr. Cassini, in the *Memoirs de l'Acad. Royal des Sciences*, An. 1706. p. 327. says, he has often observed in the Occultations of Saturn, Jupiter, and the Fix'd Stars by the Moon, that when they come near either the enlighten'd or darken'd Limb of her, their Figures, from being Circular, appear Oval, just as the Sun and Moon, rising or setting in a vaporous Horizon, appear not Circular but Elliptical.

A T

ATOME, is such a very small Particle of Matter, that it cannot physically be cut or divided into lesser Parts. *Epicurus* and his Followers first called the component Principals of all Bodies, which they supposed to be infinitely small and hard, by this Name of Atomes.

ATTICK ORDER, is a little Order, consisting of Pilasters, with a Cornice architrav'd for an Entablement.

ATTRACTION, is the Drawing of one Thing to another. Whether among the Operations of natural Bodies upon one another, there is any such Thing as Attraction, it is hard to determine; and perhaps most of those Effects, that the Ancients not knowing so well the Causes of, may be solved by Pulsion. Sir *Isaac Newton*, in his *Principia*, applies every where this Word to Centripetal Forces; and says, *Señ. 11. Lib. 1.* That Centripetal Forces are perhaps rather Impulses, if we speak Physically: But he uses the Word, as being familiar, and easier to be understood by Mathematicians. He demonstrates, *Prop. 58. Cor. 1.*

1. That if two Bodies mutually attract each other, by Forces proportional to their Distances, they will describe both about the common Centre of Gravity, and also about one another *Concentrical Ellipses*; and *Cor. 2. Prop.* the same.

2 That if two Bodies attract one another with Forces proportional to the Squares of their Distances, they will describe both about the common Centre of Gravity, and also about one another Conick Sections, having their Foci in the Centre, about

A T

which the Figures are described. And in *Prop. 73, 74. Lib. 1.*

3. He demonstrates, that any Particle of Matter within the Superficies of any Sphere or Globe, is attracted by a Force proportional to the Distance of a Particle from the Centre of the Sphere, but without the Surface of the Sphere, by a Force proportional to the Square of its Distance from the Centre.

4. And in his Opticks he shews, That of those Bodies that are of the same Nature, Kind, and Virtue, by how much less any Body is than another, the greater is its attracting Force, in Proportion to its Magnitude; as the Magnetical Attraction is stronger in a small Load-stone, in Proportion to its Weight, than in a larger one: And so, since the Rays of Light are the smallest Bodies that we know of, they must needs have the greatest and strongest attractive Force. Now, the Attraction of a Ray of Light, with Regard to its Quantity of Matter, is to the Gravity that any projected Body has, in Proportion to the Quantity of Matter in that Body; in the Ratio, compounded of the Velocity of a Ray of Light, to the Velocity of that projected Body; and of the Flexure or Curvature of the Line, which the Ray describes in the Place of its Refraction, to the Curvature or Flexure of the Line that the projected Body describes. And from hence he calculates, that the Attraction of the Rays of Light is above 1000000000000000 Millions of Millions of Times greater than the Force of Gravity on the Earth's Surface, according to the Quantity of Matter

A X

ter in each, and supposing Light to come from the Sun in about seven or eight Minutes: And in the very Point of Contact of the Rays, their attracting Force may be much greater.

ATTRACTIVE, the same with *Attracting*.

ATTRITION, in Physicks, is the Rubbing of one Thing against another; as when Ember and other Electric Bodies are rubbed, to make them attract or emit their Electric Force.

AVANT FOSS, or *Ditch of the Counterscarp*, is a Moat, or Ditch, full of Water, running round the Counterscarp, on the Outside, next to the Country, at the Foot of the Glacis. It is not proper to have such a Water-Ditch, where it can be drained dry; because it is a Trench ready made for the Besiegers to defend themselves against the Sallies of the Besieged. Besides, it hinders putting Succours into the Place, or at least makes it difficult so to do.

AUGE, the same as *Apogeeum*.

AURIGA, a Constellation, consisting of 23 Stars in the Northern Hemisphere.

AUSTRAL, the same as *Southern*. As,

AUSTRAL SIGNS, are the six last Signs of the Zodiack, being called thus, because they are on the South Side of the Equinoctial.

AUTOMATA, are Mechanical or Mathematical Instruments, that, going by Springs, Weights, &c. seem to move themselves; as a Watch, Clock, &c.

AUX, the same with *Apogeeum*.

AX, or AXE, the same with *Axis*. Which see,

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AXIOM, is such a common, plain, self-evident, and receiv'd Notion, that it cannot be made more plain and evident by Demonstration, because it is itself better known than any Thing that can be brought to prove it; as, *That nothing can act where it is not; That a Thing cannot be, and not be, at the same Time; That the Whole is greater than a Part thereof; That no Bodies can naturally go into nothing.*

AXIS. This properly signifies that straight Line in a plain Figure at rest, about which the Figure revolves, in order to produce or generate a Solid.

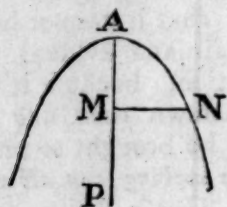
AXIS of a *Ballance*, is that Line about which it moves, or rather turns about.

AXIS of a *Cone*, is the straight Line, or Side, about which the Right-angl'd Triangle, forming the Cone, moves; and so only a Right Cone can properly have an Axis, because an Oblique Cone cannot be generated by the Motion of a plain Figure about a straight Line at rest. But because it is plain from the Definition, that the Axis of a Right Cone is a straight Line, drawn from the Centre of its Base to the Vertex, therefore the Writers of Conick Sections call likewise that Line, drawn from the Centre of the Base of an Oblique Cone to the Vertex, the *Axis of the Cone*.

AXIS of a *Conick Section*, is a straight Line dividing it into two equal Parts, and cutting all its Ordinates at Right Angles: As, if *AP* be drawn so as to cut the Ordinate *MN* at Right Angles, and dividing the Section into two equal Parts, then is the
D 3
Line

A X

Line *AP* the Axis of the Section.



AXIS (CONJUGATE, OR SECOND) of an *Ellipsis*, is the Line *FF* drawn through the Centre *C*,



parallel to the Ordinate *MN* to the Axis *AP*, being terminated by the Curve, and is the shorter of the two Axes. And the

AXIS (CONJUGATE OR SECOND) of an *Hyperbola*, is the Right Line *FF* drawn thro' the Centre *C*, parallel to the Ordinates *MN*, *MN*, to the Axis *AP*, which cuts the Curve in



the Points *A* and *P*. This Axis (tho' more than infinite) is of a determinate Length, which may

A X

be found by this Proportion; $VAM \times PM : AP :: MN : FF$.

AXIS (TRANSVERSE, OR FIRST, OR PRINCIPAL) of an *Ellipsis*, or *Hyperbola*, is the Axis *AP*, which in the *Ellipsis* is the longest, and in the *Hyperbola* cuts the Curve in the Points *A* and *P*.

AXIS of a *Cylinder*, is properly that Quiescent Right Line, about which the Parallelogram, forming the *Cylinder*, revolves. But in both Right and Oblique *Cylinders*, that Right Line, joining the Centres of the opposite Bases, is called the Axis of the *Cylinder*.

AXIS of the *Earth*, is a Right Line, about which the *Earth* revolves in the Space of 23 ho. 56 min. and 4 sec. The Axis of the *Earth* always remains parallel to itself, and is at Right Angles with the Equator.

AXIS of a *Glass*, in Opticks, is a Right Line, joining the middle Points of the two opposite Surfaces of the *Glass*.

AXIS of Incidence, in Dioptricks, is a Right Line perpendicular in the Point of Incidence to the refracting Superficies, drawn in the same Medium that the Ray of Incidence comes from.

AXIS in Opticks, is that Ray, among all those that are sent to the Eye, which falls perpendicularly upon it, and which by Consequence passes through the Centre of the Eye.

AXIS of Oscillation, is a Right Line Parallel to the Horizon, passing thro' the Centre, about which a Pendulum vibrates.

The Axis of the *Parabola* is of an indeterminate Length, that is, it is infinite. The Axis of the *Ellipsis* is determinate: And the Axis of the *Hyperbola* is of a deter

A X

determinate Length, (tho' it is more than infinite.) In the *Ellipsis* or *Hyperbola* there are two Axes, and no more; and in the *Parabola* one. And the

Axis in Peritrochio, is a Machine for the Raising of Weights, consisting of a Cylindrical Beam, which is the Axis lying Horizontally, and supported at each End by a Piece of Timber, and somewhere about it has a Kind of Tympanum, or Wheel, which is called the *Peritrochium*, in whose Circumference are Holes made to put in Staves, (like those of a Windless or Capstan,) in order to turn the Axis round more easily, and thereby to raise the Weight requir'd by Means of a Rope, which winds round the Axis.

In this Instrument, and all such like, as all Crane-Wheels, Mill-Wheels, &c. if the Power that is to lift up any Weight, be to the Weight as the Circumference of the Axis, about which the Rope is winded, is to the Circumference of the Tympanum or Peritrochium, then the Power will sustain the Weight; and if it be a little augmented it will raise it.

Axis of any Planet, is that Line drawn through the Centre, about which the Planet revolves.

All the Planets, and the Sun itself, except *Mercury* and *Saturn*, are observed to move about their Axes.

Axis of Refraction, is a Right Line drawn in the Refracting Medium, from the Point of Refraction, perpendicular to the Refracting Superficies.

Axis of a Sphere, is a straight Line drawn thro' the Centre thereof from one Side to an-

A Z

other, and is the same as the Diameter of a Sphere.

Axis of the World, is an imaginary Right Line, conceived to pass thro' the Centre of the Earth, from one Pole to the other, about which the Sphere of the World, in the *Ptolemaick* System, revolves in its Diurnal Motion.

AZIMUTH of the Sun, or any Star, is an Arch of the Horizon, intercepted between the Meridian and the Vertical Circle the Sun is in; or it is the Complement to a Quadrant of the Ortive and Occative Amplitude. As $R : T. Lat. :: T. \odot's Altit. : CO-S.$ of the Azimuth from the South at the Time of the Equinox.

AZIMUTH COMPASS, is a Compass that takes its Name from its Use, which is principally to find the Sun's Magnetical Azimuth at Sea, and does not much differ from the common Sea-Compasses.

It consists of a round Box, having a Fly and Needle in it; and upon that Box is a broad Brass Circle, having one half of the Limb thereof divided into 90 Degrees, and diagonally divided into Minutes. Upon this Limb there moves an Index; and upon this Index there is erected a Sight, which for Conveniency is to fall down with an Hinge; and from the Top of this Sight, down to the Middle of the Index, is fasten'd a Thread, to shew the Shadow of the Sun upon a Line that is on the Middle of the Index. This Compass being thus fitted, is hung in strong Brass Rings, and the Rings are hung in a Wainscot Square Box.

B A

AZIMUTH MAGNETICAL, is an Arch of the Horizon contained between the Azimuth Circle the Sun is in and the Magnetical Meridian; or it is the apparent Distance of the Sun from the North or South Point of the Compass; and is found by observing the Sun by the Azimuth Compass, either in the Forenoon or Afternoon, when he is about five or ten Degrees above the Horizon.

B.

BABYLONISH HOUR. A *Babylonish* Hour is the 24th Part of the Time from Sun-rising of one Day, to Sun-setting of the next, being reckoned from the Sun-rising.

BACK-STAFF, the same with the *Sea-Quadrant*, *Davis's*, or the *English Quadrant*, as the *French* call it. It was invented by Captain *Davis*, a *Welchman*; and is of good Use for taking the Sun's Altitude at Sea, and consists of two Concentrick Arches of Box-Wood; the Arch of the greater Circle being divided into 30 Degrees, and every Degree into five Minutes, by Means of Diagonals; and the Arch of the lesser into 60 Degrees. There are likewise three Vanes belonging to it; that being upon the Arch of 30 Degrees being called the *Sight-Vane*; that upon the Arch of 60, the *Shade-Vane*; and the other Vane, being in the Centre of the Arches, the *Horizon-Vane*.

BACULE, in *Fortification*, is a kind of Port-Cullis, or Gate, made like a Pitfall, with a Counter-

B A

poise, and supported by two great Stakes. It is usually made before the *Corps-de-Gard*, advanced near the Gates.

BACULOMETRY, according to some, is the Art of measuring accessible or inaccessible Lines, by the Help of one or more Staves.

BAKER'S CENTRAL RULE, for the Construction of Equations, is a Method of constructing all Equations, not exceeding four Dimensions, without any previous Reduction of them, or first taking away their second Term by Means of a given Parabola and a Circle. See his *Clavis Geometrica Catholica*.

BALDACHIN, in *Architecture*, is a Building in Form of a Canopy, or Crown, supported by Pillars, often serving for the Covering of an Altar. Some also call the Shell over a Door by this Name, and pronounce it *Baldaqinin*.

BALL and SOCKET, is an Instrument made of Brass, with a perpetual Screw, to hold a Telescope, Quadrant, or surveying Instrument on a Staff, for Surveying, Astronomical or other Uses.

BALLANCE, or *Scales*, is one of the six simple Powers in Mechanicks, and serves to find out the Equality or Difference of Weights in heavy Bodies. The Action of a Weight to move a Ballance is by so much greater, as the Point pressed by the Weight is more distant from the Centre of the Ballance; and that Action follows the Proportion of the Distance of the said Point from the Centre.

A Ballance is said to be in Equilibrio, when the Action of the

B A

the Weights upon each Brachium, to move the Ballance, are equal, so that they mutually destroy one another.

Unequal Weights can equiperponderate; for if the Distances from the Centre be reciprocally as the Weights, the Ballance will be in Equilibrio; as one Ounce, at nine Inches Distance from the Centre, will equiperponderate with three Ounces at three Inches Distance from the Centre: And upon this Principal is made the

Roman Ballance, or *Steel-Yard*, which weighs every Thing with one Weight.

BALLANCE of a Clock or Watch, is that Part of it which by its Motion regulates and determines the Beats: The Circular Part of it is called the Rim, and its Spindle the Verge. There belongs also two Pallets, or Nuts, that play in the Fangs of the Crown-Wheel. In Pocket-Watches, that strong Stud in which the lower Pevet of the Verge plays, and in the Middle of which one Pevet of the Crown-Wheel runs, is called the *Potans*, or rather the *Potence*; the wrought Piece, which covers the Ballance, and in which the upper Pevet of the Ballance plays, is the *Cock*; and the small Spring in Watches is called the *Regulator*.

BALLANCE (HYDROSTATICAL) is a very exact Pair of Scales, for making Hydrostatical Experiments, relating to the Gravity of Fluids; and they differ from common Scales only in having an Hook under each Scale, for suspending such Bodies that are to be immersed in Liquids.

B A

BALLANCE, or *Libra*, is the Name of one of the Twelve Signs of the Zodiack; the Character of which is ♎ ; into the first Degree of which when the Sun comes, the Autumnal Equinox happens, and is about the 12th Day of *September*.

BALLON, in Architecture, is taken for a round Globe, or Top of a Pillar.

BALLUSTER, is a little Column, or Pilaster, either round or square, adorned with Mouldings, and serving to form a Rest or Support to the Arm, and, in some Measure, to answer the Ends of a Balcony.

BALLUSTRADE, in Architecture, is the Continuity of one or more Rows of Ballusters, made of Marble, Iron, Wood, or Stone, serving either for an Elbow-Rest, as in Windows, Balconies, and Terrasses, or as a Fence, to keep off Things from without. And thus we see them around some Altars, Fonts, &c.

BAND, in Architecture, is any flat Member that is broad, and not very deep; and the Word *Face* is sometimes made to signify the same Thing.

BANQUETTE, in Fortification, is a little Foot-pace or Elevation of Earth, in Figure of a Step, or the Bottom of a Parapet, or that which the Soldiers get up to discover the Counterscarp, or to fire upon the Enemy in the Moat, or in the Covert-Way. These Banquettes are generally a Foot and an half high, and almost three Feet broad.

BAROMETER, or *Baroscope*, is an Instrument for estimating the small Variations of the Weight
or

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or Pressure of the incumbent Air. From whence we can give a tolerable Judgment of the Weather; and consists of a Tube of Glass of above thirty Inches long, hermetically sealed at one End, and being filled with Quicksilver, according to the *Torricellian* Experiment, is inverted, so as to have the open End of it immersed in stagnant Quicksilver, contain'd in a larger Glass under it; out of which open End, after such Immersion, the Quicksilver in the Tube being suffer'd to run as much as it will into the stagnant Quicksilver, there remains a Cylinder of Quicksilver suspended in the Tube, that will be always between 28 and 30 Inches in Height, above the Surface of the stagnant Mercury, according as the Pressure of the Air is more or less; and the upper Part of the Tube will be left void of common Air. This is the common Barometer; but there are others, as the

BAROMETER, (DIAGONAL,) where the Mercury, instead of rising three Inches, as in the common one, rises near thirty Inches, which is made by bending a *Torricellian* Tube of more than 58 Inches long, at the 28th Inch above the Surface of the stagnant Mercury; so that the enclosed End thereof, when the lower Part of the Tube stands upright in the stagnant Mercury, is more than thirty Inches above the Surface of the stagnant Mercury. This Barometer, of all others, is the best.

BAROMETER (MARINE,) is an Instrument serving for the same Uses at Sea, as the common Ba-

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rometer at Land, and consists of an Air-Thermometer, and a Spirit-Thermometer; for the Mercurial Barometer, especially the common ones, cannot be used at Sea, because it always requires a perpendicular Posture, and the Quicksilver vibrates therein with a great Violence, upon any Agitation. See the Description and Uses of this Instrument, by Dr. *Halley*, in the *Philosophical Transactions*, N^o 269. who carry'd one of them along with him in his last Southern Voyage; and he said, that it never failed to give him early Notice of a Storm, and of all the bad Weather they had.

BAROMETER (PORTABLE,) is one that can be conveniently and safely carried about from Place to Place, without the Danger of spilling the Mercury out of the Cistern, or Vessel, or letting the Air get in at the Bottom of the Tube; or the Mercury, included in the Tube, breaking the Top of it off.

BAROMETER (WHEEL,) is a common Barometer with an Index, that shews the Variation of the Altitude of the Mercurial Cylinder, which at most does not exceed three Inches; tho' by this Index it may be made as distinguishable as if it were three Foot, or three Yards. The Manner of making one of these Barometers is shewn us by Dr. *Hook*, in the *Philosophical Transactions*. N^o 185.

1. The higher the Barometer is above the Surface of the Earth, the lower will the Mercury in the Tube sink. This was observed first by Mr. *Pascal*, in his Treatise *De Equilibrio Liquorum*.

2. The

2. The Motion of the Mercury does not exceed three Inches in its Rising or Falling in the Barometer of the common Form.

3. The Rising of the Mercury presages, in general, fair Weather, and its Falling foul; as Rain, Snow, high Winds, and Storms.

4. In very hot Weather, the Falling of the Mercury fore-shews Thunder.

5. In Winter, the Rising presages Frost; and in Frosty Weather, if the Mercury falls three or four Divisions, there will certainly follow a Thaw; but in a continued Frost, if the Mercury rises, it will certainly snow.

6. When foul Weather happens soon after the Falling of the Mercury, there will be but a little of it; and the same will happen when the Weather proves fair, shortly after the Mercury has risen.

7. In foul Weather, when the Mercury rises much and high, and so continues for two or three Days before the foul Weather is over, then a Continuance of fair Weather follows.

8. In fair Weather, when the Mercury falls much and low, and thus continues for two or three Days before the Rain comes, then a great deal of Wet, and probably high Winds follow.

9. The unsettled Motion of the Mercury denotes uncertain and changeable Weather.

10. More Northerly Places have a greater Alteration of the Rise or Fall of the Mercury than the more Southerly.

11. Within the Tropicks, and near them, there is little or no Variation of the Height of the Mercury in all Weathers.

12. The Words that are graved near the Divisions of the Instrument, are not so strictly to be minded, although, for the most Part, it will agree with them, as the Rising and Falling of the Mercury; for if it stands at much Rain, and then rises up to Changeable, it presages fair Weather, altho' not to continue so long as it would have done, if the Mercury were higher; and so on the contrary.

BAROSCOPE, the same with *Barometer*. Which see.

BARREL, an *English* Vessel for Beer, containing 36 Gallons.

BARREL, in Clock-Work, is the Cylinder about which the Spring is wrapped.

BARRIERS, in Fortification, are great Stakes, about four or five Foot high, placed at the Distance of eight or ten Foot from one another, with their Transoms, or Overthwart-Rafters, to stop either Horse or Foot, that would enter or rush in with Violence. These Barriers are commonly set up in the void Space between the Citadel and the Town, in Half-Moons.

BASE, in Architecture, is the Foot of a Pillar, that sustains it, or that Part that is under the Body, or lies upon the Pedestal, or Zocle, when there is any; and therefore is not used for the lowest Part of a Column, but for all the several Ornaments or Mouldings that reach from the *Apophyses*, or Rising of

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of the Shafts of Pillars to the Plinth.

BASE of any Solid Figure, is its lowermost plain Side, or that on which it stands; and if the Solid has two opposite, parallel, plain Sides, and one of them is the Base, then the other is also called its Base.

BASE, in Fortification, is the exterior Side of the Polygon, viz. the Imaginary Line, which is drawn from the Flank'd Angle of a Bastion to the Angle opposite to it.

BASE LINE, in Perspective, is the common Section of the Picture, and the Geometrical Plane.

BASE, the least Sort of Ordnance; the Diameter of whose Bore is $1\frac{1}{4}$ Inch, Weight 200 Pound, Length four Foot, Load five Pound, Shot $1\frac{1}{2}$ Pound Weight, and $1\frac{1}{2}$ Inch Diameter.

BASE RING of a Cannon, is the great Ring next behind the Touch-Hole.

BASE of a Triangle. Any one Side of a Triangle may be call'd the Base; but usually and more properly, that Side that lies the lowest, or is parallel to the Horizon, is taken for the Base. And the same is to be understood of the Base of any other plain Figure.

BASILIC. This, among the Antients, was a large Hall, with Portico's, Isles, Tribunes, and Tribunal; where the Kings themselves administer'd Justice. But the Name is somewhat differently applied now-a-days, being given to Churches and Temples, as also to certain spacious Halls in Princes Courts, where the People hold their Assemblies, and the Merchants meet,

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and converse together; as that, for Instance, of the Palace at Paris.

BASILICUS, *Cor Leonis*, a Fixed Star of the first Magnitude in the Constellation *Leo*. Its Longitude is 145 deg. 21 min. Latitude 26 min. and Right Ascension 147 deg. 47 min.

BASS, in Musick, is the lowest and the fundamental Part thereof, without which any Piece of Musick is imperfect.

BASTION, in Fortification, is now what was antiently called a Bulwark; and consists of two Faces, and as many Flanks, formerly called a Gorge. It is usually made, at the Angles of Forts, of a large Heap of Earth; sometimes lined with Stone, or Brick, but usually faced with Sods, or Turfs. The Lines terminating it are two Faces, two Flanks and two Demi-Gorges. The Union of the two Faces makes the outmost Angle, called the *Angle of the Bastion*; and the Union of the two Faces to the two Flanks, makes the Side-Angles, called the *Shoulders*, or *Epaules*; and the Union of the two other Ends of the Flanks, to the two Curtains, forms the Angles of the Flanks.

BASTION (COMPOS'D,) is when the two Sides of the Interior Polygon are very unequal, which makes the Gorges also unequal.

BASTION (CUT,) is that which makes a Re-entring Angle at the Point, and is sometimes called,

BASTION with a *Tenaille*, whose Point is cut off, and makes an Angle inwards, and two Points outwards. This is done when Water, &c. hinders carrying the Bastion

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Bastion to its full Extent, or when it would be too sharp.

BASTION (DEFORMED,) is that which wants one of its Demi-Gorges, because one Side of the Interior Polygon is so very short.

BASTION (DEMI,) has but one Face and Flank, and is usually before a Horn-work, or Crown-work. This is also called an *Epaulment*.

BASTION (DOUBLE,) is that which, on the Plane of the great Bastion, hath another Bastion built higher, leaving 12 or 18 Feet between the Parapet of the lower, and Foot of the higher.*

BASTION (FLAT,) is that which is built on a Right Line. If the Distance between the Angles of the Interior Polygon be double the usual Length, then a Bastion is made in the Middle, before the Curtain. But it generally has this Disadvantage, That unless there be an extraordinary Breadth allowed to the Moat, the turning Angle of the Counterscarp runs back too far into the Ditch, and hinders the Sight and Defence of the two opposite Flanks.

BASTION (REGULAR,) is that which has its due Proportion of Faces, Flanks, and Gorges.

BASTIONS (SOLID,) are those that have their Earth equal to the Height of the Rampart, without any void Space towards the Centre.

BASTIONS (VOID OR HOLLOW,) are those that have a Rampart and Parapet ranging only round about their Flanks and Faces, so that a void Space is left towards the Centre, and the Ground is there so low, that if the Rampart be taken, no Retrenchment can be made in the

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Centre, but what will lie under the Fire of the Besieged.

BASTON, a *French* Word in Architecture, the same with *Torus*.

BATTEN, is the Workmens Name for a Scantling of Wooden Stuff, from two to four Inches broad, and about an Inch thick, and of a considerable Length.

BATTERY, in Fortification, is a Place raised on Purpose, where Cannon are planted, from thence to play upon the Enemy; the Platform on which they are fixed being made of Planks that support the Wheels of the Carriages, so as to hinder the Weight of the Cannon from sinking them into the Ground; and incline a little to the Parapet, so as to check the Recoiling of the Pieces.

In all Batteries, the open Spaces, left to put the Muzzles of the great Guns out, are call'd *Embrasures*, and the Distances between the Embrasures, *Martells*; the Guns are generally about 12 Foot distant one from another, that the Parapet may be strong, and the Gunners have Room to work.

BATTERIES (CROSS,) are two Batteries, which play athwart one another, upon the same Thing, forming there an Angle, and beating with more Violence and Destruction, because what one Bulwark shakes, the other beats down.

BATTERY (DE ENFILADE,) is one that scours or sweeps the whole Length of a straight Line.

BATTERY (EN ESCHARP,) is that which plays obliquely.

BATTERY (JOINT, OR PAR CAMERADE,) is when several
Guns

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Guns play at the same Time upon any Place.

BATTERY (DE REVERSE,) or *Murdering Battery*, is one that bears upon the Back of any Place.

BATTERY (SUNK OR BURIED,) is when its Platform is sunk, or let down into the Ground, so that there must be Trenches cut in the Earth against the Muzzles of the Guns, for them to fire out at, and to serve for Embrazures. This Sort of Battery, which the *French* call *en Terre*, and *Ruinat*, is generally used on the first Making of Approaches, to beat down the Parapet of any Place.

BATTLEMENTS, are the Tops of the Walls of Buildings, made in the Form of Embrazures and Merlons, as in fortify'd Places.

BAY, a Term in Geography, is an Arm of the Sea, coming up into the Land, and terminated in a Nook. It is a kind of lesser Gulph, bigger than a Creek; and is larger in the Middle within, than it is at the Entrance into it; which Entrance is called the *Mouth of the Bay*.

BEACONS, are Fires maintained on the Sea-Coast, to prevent Shipwrecks, and to give notice of Invasions, &c.

BEAD, in Architecture, is a Moulding, which in the *Corinthian* and *Roman* Orders, is cut and carved into short Embossments, which look like Beads worn in Necklaces; and sometimes an Astragal is thus carved.

A *Bead Plain* is sometimes set also on the Edge of each Facia of an Architrave. Its Convexity is usually about a Quarter of a Circle, and differs from a Boul-

B E

time, only in not being so large. A Bead is often placed on the Lining-Board of a Door-Case, and on the upper Edges of Skirting-Boards.

BEAM, in any Building, is a Piece of Timber lying across it, and into which the Feet of the principal Rafters are framed. No Building has less than two of these Beams, viz. one at each Head; and into these Beams the Girders of the Garret-Floor are framed; and if it be a Timber Building, into them the Teazle-Tennons of the Posts are also framed.

BEAM COMPASS, is an Instrument consisting of a square Wooden or Brass Beam, having sliding Sockets, that carry Steel or Pencil Points; and they are used for describing large Circles, where the common Compasses are useless.

BEAR. There are two Constellations of Stars called by this Name, the *Greater* and *Lesser Bear*, or *Ursa Major* and *Minor*; and the *Pole-Star* is in the Tail of the Lesser, which is never distant from the North Pole of the World above two Degrees.

BEARER, in Architecture, is a Post, or Brick-Wall, which is trimmed up between the two Ends of a Piece of Timber, to shorten its Bearing, or to prevent its Bearing with the whole Weight at the Ends only.

BEARING, in Navigation, signifies the Point of the Compass that one Place bears or stands off from another: Or if there are two Places, *A* and *B*, proposed, then *B* is said to bear from *A*, by the Quantity of an Angle contain'd under an infinitely small Part of a Rumb-Line,

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Line, drawn thro' both the Places at the Place *A*, and an infinitely small Part of the Meridian of the Place *A*.

BEATS, in a Watch, or Clock, are the Strokes made by the *Fangs* or *Pallets* of the Spindle of the Ballance; or of the Pads in a Royal Pendulum.

1. As the Beats of the Ballance in one Hour are to the Beats in one Turn of the Fusy, so is the Number of the Turns of the Fusy to the Continuance of a Watch's Going.

2. As the Number of Turns of the Fusy is to the Continuance of a Watch's Going in Hours, so are the Beats in one Hour to the Beats of the Ballance in one Turn of the Fusy.

BED of the Carriage of a great Gun, is that thick Plank which lies immediately under the Piece, being, as it were, the Body of the Carriage.

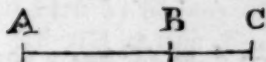
BED-MOULDING, is a Term used by Workmen for those Members in a Cornice which are placed below the Coronet, or Crown. And now-a-days, a Bed-Moulding usually consists of these four Members: 1. An O. G. 2. A Lift. 3. A large Boul-tine. 4. Under the Coronet another Lift.

BERME, in Fortification, is a little Space of Ground, three, four, or five Foot wide, left without, between the Foot of the Rampart, and the Side of the Moat, to receive the Earth that rolls down from thence, and to prevent its Falling into the Moat. Sometimes, for more Security the Berme is pallisado'd.

BEVEL, an Instrument used by Carpenters and Bricklayers for adjusting of Angles.

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BIMEDIAL. If two Medial Lines, as *AB* and *BC*, commensurable only in Power, containing a rational Rectangle, are compounded, the whole Line



AC will be irrational, and is called a *First Bimedial Line*. See *Euclid. Lib. 10. Prop. 38*.

BINOMIAL ROOT, is a Root compos'd of two Parts or Members, and no more, connected together by the Sign *Plus* $+$. Thus, $a+b$, or $2+3$ is a *Bimonial Root*, consisting of the Sum of those two Quantities. If it has three Parts, as $a+b+c$, it is called a *Trinomial Root*; if it has four, a *Quadrinomial*.

Any Root m of the Binomial $a+b$ may be extracted, or it may be raised to any given Power m by the following Series, (which is called *Sir Isaac Newton's Theorem*, he being the first Inventor thereof.)

$$\begin{aligned} a+b^m &= P+PQ^m=P^m+\frac{m}{1}AQ+\frac{m-1}{2}BQ+\frac{m-2}{3}CQ+\frac{m-3}{4}DQ \\ &+\frac{m-4}{5}EQ+\frac{m-5}{6}FQ, \&c. \end{aligned}$$

$$\begin{aligned} \text{Where } a &= P \text{ \& } P^m = A \text{ \& } Q = \frac{b}{a}, \\ \text{and } \frac{m}{1}P^mQ &= B, \text{ and } \frac{m-1}{2}BQ \\ &= C, \text{ and } \frac{m-2}{3}CQ = D, \text{ and } \frac{m-3}{4} \\ DQ &= E, \text{ and } \frac{m-4}{5}EQ = F. \end{aligned}$$

That this may be better understood, let us suppose the *Binomial*

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Binomial $10+8$ was to be raised to the fourth Power. In this Case

m will be $=4$, $P=10$, $Q=\frac{8}{10}$

$=\frac{4}{5}$. Consequently $P^m=10^4=$

$10000=A$, $m A Q=4 \times 10000 \times$

$\frac{4}{5} = \frac{160000}{5} = 32000=B$. $\frac{m-1}{2}$

$B Q = \frac{3}{2} \times 32000 \times \frac{4}{5} = \frac{6}{5} \times$

$32000 = 6 \times 6400 = 38400=C$.

$\frac{m-2}{3} C Q = \frac{2}{3} \times 38400 \times \frac{4}{5} = \frac{8}{15} \times$

$38400 = \frac{307200}{15} = 20480=D$. $\frac{m-3}{4}$

$D Q = \frac{1}{4} \times 20480 \times \frac{4}{5} = \frac{1}{5} \times 20480$

$= \frac{20480}{5} = 4096=E$. $\frac{m-4}{5} E Q = 0$

$= 0 \times 4096 \times \frac{4}{5} = 0$. Whence

$10000=A$

$32000=B$

$38400=C$

$20480=D$

$4096=E$

104976 is the fourth Power of the Binomial $10+8$.

And if the Square Root of $aa-xx$ was to be extracted, then would $m=\frac{1}{2}$; and after the same manner as before, $P=a^2$; &

$Q=\frac{-x^2}{a^2}$; & $P^m=aa^{\frac{1}{2}}=a=A$; &

$\frac{m}{1} A Q = \frac{1}{2} a \times \frac{-x^2}{a^2} = \frac{-x^2}{2a} =$

B ; & $\frac{m-1}{2} B Q = \left(\frac{\frac{1}{2}-1}{2}\right) \times \frac{-x^2}{2a} =$

$\times \frac{-x^2}{a^2} = \frac{-1}{4} \times \frac{x^4}{2a^3} = \frac{-x^4}{8a^3} =$

B L

C ; $\frac{m-2}{3} C Q = \frac{\frac{1}{2}-2}{3} \times \frac{-x^4}{8a^3} \times$

$\frac{-x^2}{a^2} = \frac{-1}{2} \times \frac{x^5}{8a^3} = \frac{-x^5}{16a^5} = D$;

$\frac{m-3}{4} D Q = \frac{\frac{1}{2}-3}{4} \times \frac{-x^5}{16a^5} \times \frac{-x^2}{a^2}$

$= \frac{-5}{8} \times \frac{x^8}{16a^7} = \frac{-5x^8}{128a^7} = E$;

$\frac{m-4}{5} E Q = \frac{\frac{1}{2}-4}{5} \times \frac{-5x^8}{128a^7} \times \frac{-x^2}{a^2}$

$= \frac{-7}{10} \times \frac{5x^{10}}{128a^9} = \frac{-35x^{10}}{1280a^9} =$

$\frac{-7x^2}{256a^9}$ &c.

BIQUINTILE, an Aspect of the Planets, when they are 144 Degrees distant from each other.

BISSEXTILE, in Chronology, is the same as our Leap-Year. And the Reason of the Name is, because in every 4th Year they accounted the 6th Day of the Kalends of March twice; for once in four Years the odd Hours, above 365 Days, made up just a whole Day, which was inserted into the Calender to the 24th of February.

BLACKNESS. The Colour so called, seems to arise from such a peculiar Texture and Situation of the superficial Parts of any black Body, that it does, as it were, deaden the Light falling upon it, and reflect none, or very little of it outwards to the Eye.

Sir Isaac Newton, in his Opticks, Book 2. Obj. 4. 17, & 18. shews, That for the Production of Black Colours, the Corpuscles must be less than any of those that exhibit other Colours.

BLACK SUBSTANCES, of all others, do soonest become hot, and burn.

BLINDS

BLINDS, in Fortification, are certain Pieces of Wood, or Branches of Trees, laid a-cross, from one Side of a Trench to the other, to sustain the Bayons or Hurdles laden with Earth; and serve to cover the Pioneers from above; and are commonly used when the Works are carry'd on towards the Glacis, and when the Trench is extended in Front towards the Place.

BLOCKADE, is encompassing any Town, or Place, so all round with arm'd Troops, that it is impossible for any Supplies to be brought to it; and so it must be starved, or surrender: But there is no Designs of taking it by Attack, &c. And when any Place is in this Condition, it is said to be *block'd up*, or *blockaded*.

BODY, in Geometry, is that which has three Dimensions, Length, Breadth, and Thickness. As a Line is formed by the Motion of a Point, and a Superficies by the Motion of a Line, so a Body is generated by the Motion of a Superficies. But,

BODY, in Natural Philosophy, is usually defin'd to be a Substance impenetrably extended, or which having *Partes extra Partes*, cannot be in the same Place with, or penetrate the Dimensions of other Bodies: Which Property Sir Isaac Newton expresses by the Word *Solidity*; and so the Idea we have of a Body proceeds from its being extended, solid, and moveable.

BOMB-CHEST, is a kind of Chest, which, being filled with Gunpowder and Bombs, (according to the intended Execution) is placed under Ground, to blow it up into the Air, together with those that stand upon it.

These Bomb-Chests are frequently used to drive the Enemy from a Post they lately possessed, or whereof they are about to take Possession; and are set on Fire by Means of a Sausage fasten'd at one End.

BOMBS, are hollow Balls of Cast-Iron, which are fill'd with whole Powder, and sometimes Nails, Pieces of Iron, &c. along with it. Their Use is to be shot out of Mortar-Pieces into besieged Towns, to annoy the Garrison, fire Magazines, &c.

The largest are about seventeen Inches in Diameter, two Inches in Thickness, carry 48 Pounds of Powder, and weigh about 490 Pounds.

BONNET, in Fortification, is a certain Work raised beyond the Counterscarp, having two Faces, which form a Salient-Angle, and, as it were, a small Ravelin, without any Trench. The Height of this Fortification is three Foot; and it is environ'd with a double Row of Palisadoes, ten or twelve Paces distant from each other. It has a Parapet three Foot high, and is like a little advanc'd *Corps de Gard*.

BONNET A PRESTRE, or the *Priest's-Cap*, in Fortification, is an Outwork, having at the Head three Salient-Angles, and two inwards; and differs from the Double Tenaille only in this, that its Sides, instead of being parallel, are made like a Swallow's Tail, that is, narrowing, or drawing close at the Gorge, and opening at the Head.

BOOTES, the Name of a Northern Constellation of the Fixed Stars; of which one, in the Skirt

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of his Coat, is called *Arcturus*, and is of the first Magnitude. This Constellation is called *Arctophylax*, and consists of thirty-four Stars.

BOREAL SIGNS, are the six first Signs of the Zodiack, or those on the Northern Side of the Equinoctial.

BOSPHORUS, in Geography, is a long narrow Sea, running in between two Lands, by which two Continents are separated, and by which Way a Gulph and a Sea, or two Seas, have a Communication one with another, as the *Thracian Bosphorus*, now called the *Straits of Constantinople*.

Bow, a Mathematical Instrument, made in Wood, formerly used by Seamen, to take the Altitude of the Sun, but now is out of Use; and consists of a large Arch of 90 Degrees, three Vanes, and a Shank or Staff.

Bow, also is a Beam of Wood, or Brass, with three long Screws, that govern or bend a Lath of Wood or Steel to any Arch; and is of great Use for drawing Arches, that have large Radii, &c. which cannot be struck with Compasses.

BOULTINE, in Architecture, is the Workmens Term for a Convex Moulding, whose Convexity is just $\frac{1}{4}$ of a Circle. This is placed next below the Plinth in the *Tuscan* and *Dorick* Capital.

BOX AND NEEDLE, is the small Compass of a Theodolite, Circumferentor, or Pain-Table.

BOYAU, or *Branch of the Trenches*, in Fortification, is a particular Ditch separated from the main Trench, which in winding about encloses different Spaces of Ground, and runs parallel with the Works and

B R

Fences of the Body of the Place; so that when two Attacks are made near one to another, the *Boyau* sometimes makes a Communication between the Trenches, and serves as a Line of Contravallation, not only to hinder the Sallies of the Besieged, but also to secure the Miners. But when it is a particular Cut, that runs from the Trenches to cover some Spot of Ground, it is then drawn parallel to the Works of the Place, that it may not be enfiladed, that is, that the Shot from the Town may not scour it.

BRANCH of the Trenches. See *Boyau*.

BREACH, in Fortification, is the Ruins that are made in any Part of the Works of a Town, &c. by playing Cannon, or springing of Mines, in order to storm the Place, or take it by Assault.

BRACE, in Architecture, is a Piece of Timber fram'd in with Bevil-Joints, and is used to keep the Building from swerving either Way. When a Brace is fram'd into the Kindlesses, and principal Rafter, it is called by some a *Strut*.

BRACKETS, in Gunnery, are the Cheeks of the Carriage of a Mortar. They are made of strong Planks of Wood of almost a semicircular Figure, and bound round with thick Iron Plates. They are fixed to the Bed by four Bolts, which are called *Bed-Bolts*; they rise up on each Side of the Mortar, and serve to keep her at any Elevation, by Means of some strong Iron Bolts, called *Bracket-Bolts*, which go thro' these Cheeks or Brackets.

BREAK

BREAK GROUND, in Fortification, signifies to begin the Works for carrying on the Siege about a Town or Fort.

BREAST SOMMERS, in a Timber Building, are the Pieces in the outward Parts of it, and in the Middle Floors, (not in the Garret and Ground-Floor,) into which the Girders are fram'd.

BREAST WORK, the same with *Parapet*.

BRIDGE of Communication, is a Bridge made over a River, by which two Armies, or Forts, that are separated by that River, have a free Communication one with another.

BROKEN RAY, or *Ray of Refraction*, in Dioptricks, is a Right Line, whereby the Ray of Incidence changes its Rectitude, or is broken in crossing the second Medium, whether it be thicker or thinner.

BURNING GLASSES are Convex or Concave Glasses, commonly Spherical, that being exposed directly to the Sun, do collect all the Rays of the Sun falling upon it into a very small Space, called the *Focus*, distant from the Glass in the Axis thereof, where Wood, or any other combustible Matter, being put, will be set on Fire. Metaline Concaves, that produce this Effect by Reflection, are called *Burning Concaves*.

The Breadth of one of these Concaves, if it be the Segment of a great Sphere, must not exceed an Arch of eighteen Degrees; and if a Segment of a small Sphere, at most, an Arch of thirty Degrees.

Kircher, in Arte Magna Lucis & Umbra, lib. 10. part 3. c. 1. says, That he found, by Experi-

ence, that the best Burning Concaves were such that did not exceed an Arch of eighteen Degrees in their Breadth.

If the Segments of a greater and a lesser Sphere lies each eighteen Degrees in Breadth, or even something greater or less, the Number of Degrees in both being the same, the Effects of the greater Segments will be greatest.

Burning Glasses, that are Segments of a greater Sphere, do burn at a greater Distance than those that are Segments of a lesser Sphere.

Schottus, in Magia Univers. part 1. lib. 7. sect. 6. p. 1418. says, That one *Manfredus Septala*, at *Milan*, made a Parabolick Speculum of this Kind, that would burn Wood at the Distance of fifteen or sixteen Paces.

Mr. Villet, at Lyons in France, made a Metalline Burning Concave of a round Figure, thirty Inches in Diameter, and about a hundred Pound Weight, the Focus, or burning Point, being distant from the Concave about three Foot, and its Bigness about half of a *Louis d'Or*. This would melt Iron in forty Seconds, Silver in twenty four, Copper in forty two; and turned Quarry Stone into Glass in forty five, and Mortar in fifty three Seconds; and melted a Piece of Watch-Spring in nine Seconds. See the *Philosoph. Trans. N° 6. pag. 418.* and the *Diary of the Learned at Paris, Ann. 1679.*

Mr. Villet afterwards made another of thirty four Inches in Diameter, that would melt all Sorts of Metals of the Thickness of a Crown Piece in less than a Minute, and vitrify Brick in the

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same Time. *Philosoph. Trans.* N^o. 49.

In the *Philosoph. Trans.* N^o. 188. and the *Acta Eruditorum*, Ann. 1687. p. 52. you have mention'd a Copper Burning-Concave, made at *Lusace* in *Germany*, of near three *Leipsick* Ells in Diameter, and its Focus two Ells off, being scarce twice so thick as the Back of a common Knife, and whose Force is incredible; for a Piece of Wood put in the Focus, flames in a Moment so as it can hardly be put out by a fresh Wind. A Piece of Lead or Tin three Inches thick, will be melted quite through in three Minutes Time. A Piece of Iron or Steel is presently red hot, and soon after hath a Hole burnt through it. Copper, Silver, &c. applied to the Focus, melt, and the Iron aforesaid will melt in five or six Minutes. Slate, in a few Minutes, will be turn'd into black Glass. Tiles and Earthen Potsheds, in a little Time, do melt into Glass. Bones are turn'd into black Glass, and a Clod of Earth into greenish Glass.

Mr. *Tschirnbusan* is said to have made Convex Burning-Glasses of three or four Foot in Diameter, and whose Focus is twelve Feet distant, and of an Inch and a half in Diameter; and to make this Focus yet stronger, he contracts it by a second Lens, placed parallel to, and at a due Distance from the first, and so makes the Focus but eight Lines in Diameter. This Glass vitrifies Tiles, Slates, Pumice-Stones, &c. in a Moment. It melts Sulphur, Pitch, and all Rosins, under Water. Any Metal exposed to it, in little Lumps upon a Coal, melts

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in a Moment, and Iron Sparkles as in a Smith's Forge. All Metals vitrify on a Piece of China Plate, if it be not so thin as to melt itself; and Gold, in vitrifying, receives a Purple Colour. See *Le Historie de l'Academy des Siences*, Ann. 1699.

Sir *Isaac Newton* presented a Burning-Glass to the Royal Society, consisting of seven Concave Glasses, so placed, as that all their Foci join in one physical Point. Each Glass is about eleven Inches and a half in Diameter: Six of them are placed round the Seventh; to which they are all contiguous, and they compose a kind of Segment of a Sphere, whose Subtense is about thirty four Inches and a half; and the Central-Glass lies about an Inch further in than the rest. The common Focus is about twenty two Inches and a half distant, and of about half an Inch in Diameter. This Glass vitrifies Brick or Tile in a Moment, and in about half a Minute melts Gold.

A certain Artificer of *Dresden* is said to have made very large Burning-Concaves of Wood, whose Effects were little inferior to those of the Burning-Speculums of Mr. *Tschirnbusan*.

Zahn, in *Oculo. Artific. fundam.* 3. *Syntagm.* 3. *cap.* 10. f. m. 634. says, That one *Newman*, in the Year 1699. at *Vienna*, made a Burning-Speculum of stiff Paper and Straw glewed to it.

And *Zacharias Traberus*, in *Nerv. Optic. lib.* 2. c. 12. *prop.* 5. cor. 2. says, That very large Burning-Speculums may be made of thirty, forty, or more Con-

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Concave-Speculums, or square Pieces of Glas, conveniently placed in a large turn'd wooden Concave, or Dish, and that their Effect will not be much less than if the Superficies were contiguous.

BURNING ZONE. See *Zone*.

BUTMENTS, in Architecture, are the Masons and Bricklayers Term for those Supports or Props on or against which the Feet of Arches rest: Also little Places taken out of the Yard of the Ground-Plot of a House for a Buttery, Scullary, &c. are sometimes called Butments.

BUTTRESS, is an Arch, or Mass of Stone, serving to support the Sides, a Building, Wall, &c. on the Outside, and are chiefly used in such Buildings as are of the Gothick Kind.

BYQUARTILE, the same with *Biquartile*.

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CADENCE, or *Close*, in Musick, is a Conclusion of a Piece of Musick. In some Keys it is not set in; and in long Pieces of Musick there are several Cadences. The more there are, the pleasanter is the Musick, provided they are artfully disposed.

CAISSON, or *Superficial Fourneau*, is a wooden Case, or Chest, into which three, four, five, or six Bombs are put, according to the Execution they are to do, or as the Ground is firmer or looser. Sometimes the Chest is only fill'd with Powder: When the Besieg'd dispute every Foot of Ground, this Caisson is

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buried under some Work the Enemy intends to possess himself of; and when he is Master of it, they fire it by a Train convey'd by a Pipe, and so blow them up.

CALCULUS DIFFERENTIALIS, is the Arithmetick of the infinitely small Differences between variable Quantities, and is by us in *England* called *Fluxions*.

Mr. *Leibnitz*, about the Year 1676, by most of the Foreigners, is allow'd to have first invented this Doctrine of infinitely small Quantities, who called it the *Calculus Differentialis*; but it is plain, from Sir *Isaac Newton's* Papers, that Sir *Isaac* was the first Inventor of it, who being too free in communicating it to Mr. *Leibnitz*, he stole it from him; and that the Suspicion might be the less, he invented different Words and Notes from those in Sir *Isaac's* Method. As for the Fluxion of x , he puts dx ; and for y , dy ; and these are used by almost all the Foreigners. Yet even *James Bernoulli*, in the *Leipsick Acts* for January 1691. owns, that our famous Dr. *Barrow*, (before Sir *Isaac*, or *Leibnitz* either,) had given some Specimens of this Method, above ten Years before that Date, in his Geometrical Lectures, and of which all his Apparatus of Propositions there contain'd, are so many Examples. He also acknowledges, that Mr. *Leibnitz's* Method of the *Calculus Differentialis* is founded upon Dr. *Barrow's*, and differs from it only in some Notes and compendious Abridgments.

CALCULUS EXPONENTIALIS, is the Manner of finding the Fluxions; and of summing up

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of the Fluxions of Exponential Quantities.

CALCULUS INTEGRALIS, is the Method of finding the proper flowing Quantity of any given Fluxion, and is the Reverse of the *Calculus Differentialis*, which finds the Fluxion from the flowing Quantities.

CALENDAR, much the same as Almanack. Which see. The Word *Calendar* seems to come from the *Calende*, which, among the *Romans*, were the first Days of every Month.

There have been many Corrections and Alterations of the Calendar. The first was made by *Numa Pompilius*; and this afterwards was much improv'd by *Julius Caesar*, and was by him called the *Julian Account*, which, in our Nation, and some other Places, is still retain'd, and called the *Old Style*.

Pope Gregory XIII. pretended to reform it again, and ordered his Account to be current, as it is still in all the Roman Catholick Countries, where it is called the *Gregorian Calendar*; and with us *New Style*. It begins eleven Days before ours.

CALENDAR (ASTRONOMICAL.)
See *Astronomical Calendar*.

CALENDS; so the *Romans* called the first Days of every Month, from the Greek Word *Caleo*, to call; because antiently counting their Months by the Motion of the Moon, there was a Priest appointed to observe the Times of the New Moon; who having seen it, gave notice to the President over the Sacrifices, and he called the People together, and declared to them how they must reckon the Days until the

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Nones, pronouncing the Word *Caleo* five Times if the *Nones* did happen on the 5th Day, or seven Times if they happened on the 7th Day of the Month.

CALIBER, or **CALIPER**, is the Bigness, or rather Diameter of a Piece of Cannon, or any Fire-Arms at the Mouth.

CALIPTERS, is an Instrument made like a Sliding-Rule, to embrace the two Heads of any Cask to find the Length of it. There are also *Calipters*, or *Caliper-Compasses*, which are used by Gunners, with crook'd or bowing Legs, to measure the Diameters of Bullets and Cylinders of Guns, &c.

CALLIPICK PERIOD, was an Improvement of the Cycle of Meton of nineteen Years, which *Callipus*, a famous Grecian Astronomer, finding in reality to contain nineteen of *Nabonassar's* Years, four Days, and $\frac{331}{459}$, he, to avoid Fractions,

quadrupled the Golden Number, and by that means made a new Cycle of seventy six Years; which Time being expir'd, he supposed the Lunations, or Changes of the Moon, would happen on the same Day of the Month and Hour of the Day, that they were on seventy six Years before.


CAMBER-BEAM, in Architecture, is a Beam, or Piece of Timber cut hollow, or arching in the Middle. They are used in Platforms, Church-Leads, &c. and are very proper wherever is occasion for long Beams, being much stronger than flat Beams of the same Size; for being laid with the hollow Side down-

downwards, and having good Butments at the Ends, they serve for a Kind of Arch.

CAMERA OBSCURA, is the Name of an Optick Machine; wherein (the Light only coming through a double Convex-Glass,) Objects exposed to broad Day-light, and opposite to the Glass, are represented inverted upon any white Matter, placed within the Machine in the Focus of the Glass. The first who observed this Phænomena was *Baptista Porta*, lib. 4. c. 2. *Magia Naturalis*.

The Representations of Objects in this Machine are wonderfully pleasant, not only because they appear in the just Proportions, and are endued with all the natural Colours of their Objects, but likewise shew their various Motions, which no Art can imitate; and a skilful Painter, by means of one of these Machines, may observe many Things from the Contemplation of the appearing of Objects therein, that will be an Help to the Perfection of the Art of Painting; and even a Bungler may accurately enough delineate Objects by Means of it.

Mr. *s'Gravesande*, at the End of his *Perspective*, has given the Description and Use of two Machines of this Kind, being the best that have as yet been made, especially the former.

CANCER, one of the twelve Signs of the Zodiack, drawn on the Globe in the Figure of a Crab, and thus mark'd , and that Circle that is parallel to the Equinoctial, and passes through the Beginning of this Sign, is called the *Tropick of Cancer*, or the *Northern Tropick*;

to which Circle when the Sun comes, it makes the Summer Solstice, and is turning his Course back again towards the Equinoctial.

CANIS *Major* and *Minor*, the greater and lesser Dog, are two Constellations of Stars drawn upon the Globe in Figure of this Animal, and the greater of them has in his Mouth that vast Star called

CANICULUS, or the *Dog-Star*, which rising and setting with the Sun from about the 24th of *July* to the 28th of *August*, gives occasion to that Time, which is usually very hot and dry, to be called the *Canicular*, or *Dog-Days*.

CANNON, a Piece of Ordnance. See *Ordnance*.

CANNON-ROYAL, is a Piece of Ordnance, eight Inches in Diameter in the Bore, twelve Foot long, weighs eight thousand Pounds; its Charge is thirty two Pounds of Powder; its Ball is forty eight Pounds Weight, and seven Inches and a half in Diameter, and shoots point-blank one hundred and eighty five Paces.

CANON, in Arithmetick, is a Rule to solve all Things of the same Nature with the present Enquiry. Thus every last Step of an Equation in Algebra, is such a Canon, and if turn'd into Words, is a Rule to solve all Questions of the same Nature with that proposed. The Tables of Logarithms, Artificial Sines, and Tangents, are called likewise by the Name of *Canon*.

CANON, in Musick, is a Line of any Length, shewing by its Divisions, how musical Inter-

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vals are distinguish'd according to the Ratio's or Proportions that the Sounds terminating the Intervals bear one to another, when consider'd according to their Degree of being acute or grave. As the Diapason consists in a double Ratio, the Diapente in a Sesquialteral, the Diatessaron in a Sesquitercian, and the Tone itself, by which the Diapente and the Diatessaron differ, in a Sesquioctave, &c.

CANTALIVERS, in Architecture, are a kind of Modillions; only those are plain, but these are carv'd. They are much the same with Cartouzes, and are set as Modillions are, under the Corona of the Cornish of a Building.

CANVAS-BAGS, or *Earth-Bags*, are Bags holding about a Cubick Foot of Earth, and are used to raise a Parapet in haste, or to repair one that was beaten down. They are chiefly used when the Ground is rocky, and affords no Earth to carry on the Approaches: Then are these Bags of Earth very necessary, which can be fill'd at another Place, and remov'd at Pleasure. These Bags are sometimes, upon occasion, fill'd with Powder.

CAP-SQUARES, are broad Pieces of Iron on each Side of the Carriage of a great Gun, and lock'd over the Trunnions of the Piece with an Iron Pin. Their Use is to keep the Piece from flying out of the Carriage when it is shot off with its Mouth lying very low, or, as they call it, under Metal.

CAPACITY, is the solid Content of any Body; also our hol-

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low Measures for Wine, Beer, Corn, &c. are called Measures of Capacity.

CAPE, or *Promontory*, is any high Land, running out with a Point into the Sea; as *Cape Verde*, *Cape Horn*, the *Cape of Good Hope*, &c.

CAPELLA, a bright Fix'd Star in the Left Shoulder of *Auriga*, whose Longitude is seventy seven Deg. sixteen Min. Lat. twenty two Deg. fifty Min. and Right-Ascension seventy three Deg. seven Min.

CAPITAL of a *Bastion*, is a Line drawn from the Angle of a Polygon to the Point of the Bastion, or from the Point of the Bastion to the Middle of the Gorge. These Capitals are from thirty five to forty Fathom in Length, that is, from the Point of the Bastion to the Place where the two Demi-Gorges meet.

CAPITAL, or *Chapital*, or *Chapiter*, signifies the Top of a Pillar; and this is different, according to the different Orders.

CAPITAL-LINE. See *Line*.

CAPONNIERE, is a cover'd Lodgment of about four or five Foot broad, encompassed with a little Parapet of about two Foot high, which serves to support divers Planks laden with Earth.

This Lodgment is large enough to contain fifteen or twenty Soldiers, and is usually placed upon the Extremity of the Counterscarp, having sometimes several little Embrasures made therein, usually called *Madnesses*. They are generally on the Glacis, or in dry Moats.

CAPRICORN, the *Goat*, one of the Zodiacal Signs, mark'd thus ♈. The Tropic of *Capricorn*, or the Southern Tropic, passes through

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through the first Degree of this Sign, at twenty three Deg. thirty Min. Distance from the Equinoctial.

CARACT, is the $\frac{1}{24}$ Part of any Quantity, or Weight; being a Word used by *Minters* and *Goldsmiths*, who divide it into four Parts, which they call Grains of a Carat; and one of these they subdivide into Halves and Quarters.

CARAT. A Carat of Gold is properly the Weight of twenty four Grains, or one Scruple; so that 24 Carats make an Ounce.

And if an Ounce of Gold be so pure, that in its Purification with Antimony, or otherwise, it loses nothing at all, it is then said to be Gold of twenty four Carats: If it loses one Carat, it is then Gold of twenty three Carats: If it loses two Carats, it is called Gold of twenty two Carats, &c.

A Carat of Diamonds, Pearls, or Precious - Stones, is the Weight of four Grains only.

CARCUS, is an Iron Case, or hollow Capacity, about the Bigness of a Bomb; sometimes made all of Iron, except two or three Holes, through which the Fire is to blaze; and sometimes made only of Iron Bars, or Hoops, and then cover'd over with pitch'd Cloth, Hemp, &c. and fill'd with several Kinds of Materials for firing of Houses. They are thrown out of Mortar-Pieces into besieg'd Places, &c.

CARD. See *Chard*.

CARDINAL-WINDS, are the South, West, North, and East Points of the Compass: Also the Equinoctial and Solstitial Points of the Ecliptick, are called the *Four Cardinal-Points*.

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CARDINAL-SIGNS, are the Signs of the Zodiack, *Aries*, *Libra*, *Cancer*, and *Capricorn*.

CARRIAGE of a great Gun, is the Frame of Timber, on which a Piece of Ordnance is laid, fix'd, and mounted. The common Proportion is one and a half of the Length of the Gun for the Carriage; the Wheels half of the Length of the Piece in Height, and four Times the Diameter of the Bore of the Gun, gives the Depth of the Planks at the Fore-End, in the Middle three and a half.

CARTOUCHE, the same as *Cartridge*.

CARTRIDGES, or *Carriages*, are Cases of Paper, or Parchment, fitted exactly to the Bore of a Piece of Ordnance, and containing its due Charge of Powder.

CARTOUZES, are Ornaments of carv'd Work, of no determinate Figure, whose Use is to receive a Motto, or Inscription.

CARYATIDES, from the Greek *Cariatydes*, a People of *Caria*. These in Architecture signify certain Figures of Captive Women, with their Arms cut off, cloathed after the Manner of that Nation, down to their Feet, and serve, instead of Columns, to support the Entablements.

CASCABELL, is the hindermost round Knob, or the utmost Part of the Breech of a Piece of Ordnance.

CASCADE, an *Italian* Word, that signifies a Fall of Waters, either natural or artificial.

CASCAN, in Fortification, is a certain Hole, or hollow Place in Figure of a Well, from whence a Gallery, dug in like Manner under Ground, is convey'd to
give

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give Air to the Enemies Mine. Some of these are more hollow than others, and they are usually made in the Retrenchment of the Platform near the Wall.

CASEMATE, in Fortification. This sometimes signifies a Well, with its several subterraneous Branches, or Passages, dug in the Passage of the Bastion, till the Miner is heard at Work, and Air given to the Mine. It sometimes signifies

A Vault of Stone-Work in that Part of the Flank of a Bastion being next to the Curtain, on Purpose to fire upon the Enemy, and to defend the Face of the opposite Bastion of the Moat.

It sometimes consists of three Platforms, one above another. the Terre-plan of the Bastion being the highest. Behind the Parapet that fronts along the Line of the Flank, there are Guns placed, loaded with Cartridges of small Shot, to scour along the Ditch; and these are cover'd from the Enemies Batteries by Earth-Works, faced or lined with Walls, and are called Orillons, or Epaulments.

CASERN, in Fortification, is a little Room, Lodgment, or a Building, erected between the Houses of fortified Towns and the Rampart, serving as Apartments, or Lodgings, for the Soldiers of the Garrison, to ease the Garrison: There are commonly two Beds in each Casern for six Soldiers to lie in, three and three in a Bed; but the third Part of them being always upon the Guard, there are but four left in the Casern, two in a Bed.

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CASE-SHOT, are Musket-Balls, Stones, old Iron, &c. put into Cafes, and so shot out of great Guns; and they are principally used at Sea, to clear the Enemies Decks, when they are full of Men.

CASSIOPEA, the Name of one of the Constellations of the Fix'd Stars in the Northern Hemisphere, consisting of twenty five Stars, and is placed opposite to the great Bear, on the other Side the Pole-Star.

CAST a Point of Traverse, in Navigation, signifies to prick down on the Chart the Point of the Compass any Land bears from you, or to find on what Point the Ship bears at any Instant, or what Way the Ship has made.

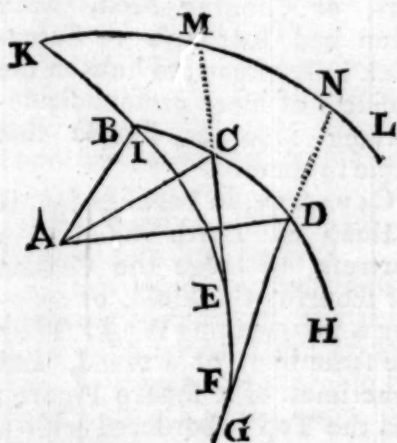
CASTOR, a Fix'd Star of the second Magnitude in *Gemini*, whose Longitude is one hundred and five Deg. forty one Min. Latitude ten Deg. two Min.

CASTOR and Pollux, are two Meteors, that sometimes, in a great Storm at Sea, appear sticking to some Part of the Ship, in the Shape of fiery Balls; and when but one of them is seen, it is called *Helena*; and both of them are by some called *Tyndarides*.

A Constellation of the Fix'd Stars being the same with *Gemini*, one of the twelve Signs of the Zodiack, is called by the Name of *Castor and Pollux*.

CATACAUSTICKS, or *Causticks by Reflection*. These Curves are generated after the following Manner: If there be an infinite Number of Rays, as *AB*, *AC*, *AD*, &c. proceeding from the
radia-

radiating Point *A*, and reflected at any given Curve, *B D H*, so that the Angles of Incidence be still equal to those of Reflection, then the Curve *B E G*, to which the reflected Rays, *B I*, *C E*, *D E*, &c. are Tangents continually; as in the Points *I*, *E*, *F*, &c. is called the *Caustick by Reflection*. Or it is the same Thing, if we say, that a *Catacaustick* Curve is that form'd by joining the Points of Concurrence of the several reflected Rays. And if the reflected Ray *I B* be produced to *K*, so that $AB = BK$, and the Curve *K L* be the Evoluta of the Caustick *B E G*, beginning at the Point *K*, then



the Portion of the Caustick $BE = AC - AB + CE - BI$ continually. Or if any two incident Rays, as *AB*, *AC*, be taken, that Portion of the Caustick, that is evolved, while the Ray *AB* approaches to a Coincidence with *AC*, is equal to the Difference of those incident Rays + the Difference of the reflected Rays.

When the given Curve *B D H* is a Geometrical one, the Caustick will be so too, and the

Caustick will always be reliable.

The Caustick of the Circle is a Cycloid, form'd by the Revolution of a Circle along a Circle.

The Caustick of the vulgar Semi-Cycloid, when the Rays are parallel to the Axis thereof, is also a vulgar Cycloid, described by the Revolution of a Circle upon the same Base.

The Caustick of the Logarithmick Spiral is the same Curve.

CATACOUSTICKS, or *Cataphonicks*, is the Science of reflected Sounds; or that which treats of the Doctrine and Proportions of Echoes.

CATADIOPTICAL TELESCOPE, or *Reflecting Telescope*. See *Telescope*.

CATARACT, is a Precipice in the Channel of a River, caused by Rocks, or other Obstacles, hindering the Course of its Stream, from whence the Water falls with great Impetuosity; as, the River *Nile* has two; the River *Wologda* in *Muscovy*; the River *Zaire* in the Kingdom of *Congo*, &c.

CATCHES, are those Parts of a Clock that hold by hooking, and catching hold of.

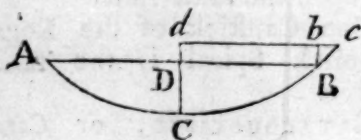
CATENARIA, the Name of a Curve-Line, form'd by a Rope, hanging freely from two Points of Suspension, whether the Points be horizontal, or not.

The Nature of this Curve was sought after in *Galileo's* Time; but little was done concerning it, till the Year 1690 *Mr. Bernoulli* proposed it as a Problem to the Mathematicians of *Europe*.

This Catenary is a Curve of the Mechanical Kind, and cannot

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cannot be expressed by a determinate Algebraick Equation. If you suppose a Line heavy and flexible, firmly fixed to the Points *AB*, the Extremes thereof, then the Weight thereof will bend it into the Curve *ACB*, called the *Catenary*, whose fundamental Property, if *DB*, *dc*, be parallel to the



Horizon, *CD* perpendicular to *AB*, and *Bb* parallel to *CD*, and the Points *D* and *d* infinitely near to one another, and *a* be any given Quantity will be this, viz. $bc : Bb :: a : CB$. The Demonstration of this Property, as also of several others, may be seen in what was published by Dr. Gregory in the Year 1697, for the Month of August.

CATHETUS, the perpendicular Leg of a Right-angled Triangle, is often called by this Name. Also *Cathetus*, in *Catoptricks*, is a Line drawn from the Point of Reflection perpendicular to the Plane of the Glass.

CATHETUS, in Architecture, is taken for a Line supposed to cross the Middle of a Cylindrical Body directly, as of a Baluster, or Column. In the Ionick Chapter it is also a Line falling perpendicularly, and passing thro' the Centre or Eye of the Voluta.

CATHETUS of Incidence, is a Right Line drawn from a Point of the Object, perpendicular to the reflecting Line.

CATHETUS of Reflection, or *Cathetus of the Eye*, is a Right

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Line, drawn from the Eye, perpendicular to the reflecting Line.

CATOPTRICKS, is that Part of Opticks that treats of Reflex Vision, and explains the Laws and Properties of Reflection.

This is a very diverting and useful Part of Knowledge. The Phenomena arising from the Effects of the Instruments that have been invented in this Art, are surprizing, even to those who know the Reasons of the Phenomena they exhibit: But many of those, who are ignorant thereof, have thought that those wonderful Phenomena were produced by Divination. And those crafty Knaves, called Conjurers, or Cunning Men, have often had Recourse to Catoptrick Instruments, to help on the Business of more profoundly deceiving ignorant People that came to them.

CAVALIER, in Fortification, is a Heap of Earth raised in a Fortrefs, to lodge the Cannon for scouring the Field, or opposing a commanding Work. They are sometimes of a round, and sometimes of a square Figure; and the Top is bordered with a Parapet, to cover the Cannon mounted in it. There must be twelve Foot between Cannon and Cannon; and if they are raised on the Inclosure of any Place, whether in the Middle of the Curtain, or in the Gorge or Bastion, they are generally fifteen or eighteen Foot high above the Terre-Plan of the Rampart.

A *Cavalier* is sometimes called a *Double Bastion*; and the Use thereof is to overlook the Enemy's Batteries, and to scour their Trenches.

CAVAZION,

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CAVAZION, in Architecture, is the Digging or Hollowing away of the Earth from the Foundation of a Building; and this may be one sixth Part of the Height of the whole Building.

CAVETTO, is a round concave Moulding, having a quite contrary Effect to the Quarter-Round. The Workmen call it a *Mouth*, when it is in its natural Situation; and *Throat*, when it is turned upside down.

CAUKING, in Architecture, is Dove-tailing across.

CAULICOLI, in Architecture, are the little carved Scrolls, which are under the *Abacus* in the Corinthian Order.

CAUSTICK CURVES. See *Catacausticks*, and *Diacusticks*.

CAZERN. See *Casern*.

CAZEMATE. See *Casemate*.

CEGINUS, a Fixed Star of the first Magnitude, in the left Shoulder of *Bootes*; whose Longitude is 194 deg. 5 min. Lat. 49 deg. 33 min. and Right Ascension 215 deg. 39 min.

CELERITY, is the Swiftmess of any Body in Motion; and is defined to be an Affection of Motion, by which any movable Body runs thro' a given Space in a given Time.

CELESTIAL GLOBE. See *Globe*.

CENTAUR, a Southern Constellation, consisting of forty Stars.

CENTESM, is the hundredth Part of any Thing.

CENTRAL RULE, is a Rule found out by Mr. *Thomas Baker*, and by him publish'd, in his *Geometrical Key*, in the Year 1684; whereby he finds the Centre of a Circle, that is to cut a given Parabola in as many Points as

C E

an Equation, to be constructed, has real Roots: And by that Means he constructs all Equations, not exceeding Biquadratics, without any previous Reduction or Alteration whatsoever.

CENTRE of a Circle, is a Point within the same, from whence all Right Lines, that are drawn to the Circumference of the Circle, are equal to each other.

CENTRE of a Dial, is that Point where the Axis of the World intersects the Plane of the Dial: And so, in those Dials that have Centres, it is that Point wherein all the Hour-Lines meet. All Dials have Centres, but such as are parallel to the Axis of the World.

CENTRE of an Ellipsis, is that Point thereof, wherein the Diameters intersect each other; or it is that Point bisecting any Diameter.

CENTRE of the Equant, in the old Astronomy, is a Point in the Line of the *Aphelion*, being so far distant from the Centre of the *Excentrick*, towards the *Aphelion*, as the Sun is from the Centre of the *Excentrick*, towards the *Perihelion*.

CENTRE of Gravity of any Body, is such a Point thereof, that if the Body be supported on it, or suspended from it, the Body will rest in any given Situation.

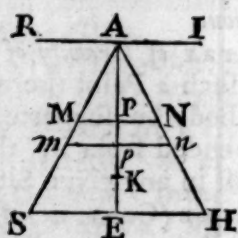
CENTRE (COMMON) of Gravity of two Bodies, is a Point in a Right Line, joining their Centres, so posited, that their Distances from it are reciprocally proportional to the Weights of the Bodies. And if there be another Body in the same Right Line, so placed, that its Distance from

C E

from some Point in it be reciprocally, as the Weight of both the former Bodies taken together, that Point shall be the Common Centre of Gravity of all three of the Bodies. Understand the same of the Common Centre of Gravity of four, or more Bodies.

The Common Centre of Gravity of two or more Bodies, does not change its State of Motion, or Rest, by the Actions of Bodies among themselves. And so the Common Centre of Gravity of all Bodies, mutually acting upon each other, (all external Actions and Impediments being excluded) will either rest, or move uniformly forwards in a Straight Line.

If the Elements, or infinitely small Parts, as Mm , Nn , of any Figure SAH , be conceived as so many Weights hung to the Axis AE , the Point of Suspension being in the Vertex A , the Centre of Gravity K , in that Axis, will be determined, dividing the Sum of the Momenta of all those small Weights by the Sum of them of all, that is,



if $AP=x$, $MP=y$, $Pp=z$, then is one of the small Weights, $2yx$, and the Sum of them all, $2Syx$, the Momentum of one of the Small Weights is $2yx^2$, and the Sum of them all is $2Syx^2$;

C E

whence the Distance of the Centre of Gravity from the Vertex, Sy^2x and so when you have the flowing Quantities of these Fluxions, y^2x , and y^2x , the Centre of Gravity will be determined.

Every Figure, whether superficial or solid, which is generated by the Motion of a Line or Figure, is equal to the Rectangle under the generating Magnitude, and the Way of its Centre of Gravity, or the Line which the Centre of Gravity describes.

Mr. Borellus, in *Lib. de Motu Animalium*, Part 1. Prop. 134. says, That the Centre of Gravity of a human Body, when extended, is between the Nates and Pubis; and so the whole Gravity of the Body centres in that Place where Nature has allotted the Seat of the Genitals; which, no doubt, was for facilitating the Business of Coition.

CENTRE of an Hyperbola, is that Point wherein the Diameters meet; or it is that Point bisecting any Diameter, and is without the Figure, and common to the opposite Section.

CENTRE of Magnitude of any Body, is that Point which is equally remote from its extreme Parts. In Homogeneous Bodies, that can be cut into like and equal Parts, according to their Length, the Centre of Gravity is the same as the Centre of Magnitude.

Such an Homogeneous Body is, for Example, a Leaden Cylinder, that can be cut lengthwise into like Parts; for if the Length

C E

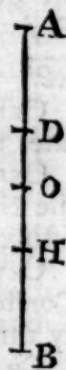
Length thereof be conceived to be divided into three or more equal Parts, it will be cut into equal and like Cylinders.

CENTRE of Motion of any Body, is the Point about which any Body moves, when fasten'd any ways to it, or made to revolve round it.

CENTRE of Oscillation, is a Point, wherein, if all the Gravity of a Compound Pendulum be collected, every Oscillation will still be performed in the same Time as before. Or it is that Point of a Compound Pendulum, whose Distance from the Point of Suspension is equal to the Length of a Simple Pendulum, whose Oscillations are performed in the same Time as the Oscillation of the Compound ones.

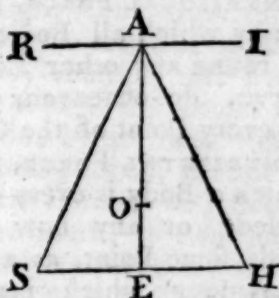
If several Weights, *D, H, B*, being supposed to gravitate in the Points *D, H, B*, do keep at the same Distance, with Regard to one another, and form the Point of Suspension *A*, on the inflexible Rod *AB*, and, oscillating about the Point *A*, do make a Compound Pendulum, the Distance of *O*, the Centre of Oscillation from the Point of Suspension *A*, will be had, by drawing each of the Weights into the Squares of their Distances, and dividing the Aggregate by the Sum of the Momentums of the same Weights.

The Centre (*O*) of Oscillation of a Straight Line *AB* will be distant from *A*, the Point of Suspension, $\frac{2}{3}$ of the whole Line. The Centre (*O*) of Oscillation of the Equicrural Triangle *ASH*,



C E

oscillating about the Axis *RI*, parallel to the Base *SH*, will be distant from *A*, the Point of Suspension, $\frac{1}{3}$ of *AE*.



And if *SAH* was the Common Parabola, *A* being the Vertex, and *AE* the Axis, then the Distance $AO = \frac{1}{3} AE$.

CENTRE of Percussion, is that Point of a Body in Motion, wherein all the Forces of that Body are united into one; or it is that Point wherein the Stroke of the Body will be greatest; and is much the same, with Respect to the Forces, as the Centre of Gravity to the Weights.

The Centre of Percussion is the same as the Centre of Oscillation, if the Striking Body revolves about a fixed Point; whence a Stick of a Cylindrical Figure, supposing the Centre of Motion at the Hand, will strike the greatest Blow at a Distance, about $\frac{2}{3}$ of its Length from the Hand.

The Centre of Percussion is the same as the Centre of Gravity, if all the Parts of the striking Body are carry'd by a parallel Motion, or move with the same Velocity.

CENTRE of a Regular Polygon, or Regular Body, is the same as that of the inscrib'd Circle or Sphere.

CENTRE

C E

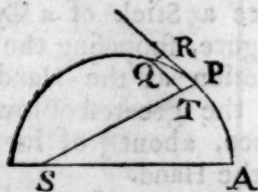
CENTRE of a Sphere, is a Point in the Middle thereof, from whence all Right Lines, drawn to the Superficies, are equal to one another.

CENTRIFUGAL FORCE, is that Force by which all Bodies that move round any other Body in a Curve, do endeavour to fly off in every Point of the Curve.

CENTRIPETAL FORCE, is that by which a Body is every where impelled, or any how tends towards some Point, as a Centre. Among which may be reckon'd Gravity, whereby Bodies tend towards the Centre of the Earth; the magnetical Attraction whereby it draws Iron; and that Force, whatever it be, whereby the Planets are continually drawn back from Right-lin'd Motions, and made to move in Curves.

The Centripetal and Centrifugal Force of the same revolving Body in the same Point of the Curve that it describes, are always equal and contrary.

If a Body *P*, in revolving about the Centre *S* describes the Curve *APQ*, and the Right Line *PR* touches the Curve in



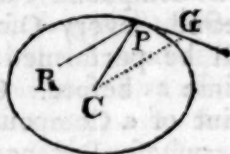
P, and the Line *QR* be drawn parallel, and infinitely near to *SP*, and *ST*, be drawn perpendicular to *SP*, then will the Centripetal Force in any Point *P* of the Curve be reciprocally proportional to

$$\frac{SP^2 \times QT^2}{QR}$$

C H

If the Periodick Times of Bodies, revolving in Circles, be as any Power R^n of the Radii, then the Centripetal Force will be reciprocally as the Power R^{2n-1} . And contrarywise,

If the Body *P*, tending to any given Point *R*, moves in the Perimeter of any given Conick Section, whose Centre is *C*, and



if the Line *CG* be drawn from the Centre *C*, parallel to the Ray *RP*, meeting the Tangent to the Section at *G*, the Law of the Centripetal Force will be as $\frac{CG^2}{RP^2}$.

CENTROBARYCAL, is what relates to the Centre of Gravity.

CEPHEUS, a Constellation in the Northern Hemisphere, consisting of seventeen Stars.

CETUS, the *Whale*, a Southern Constellation, consisting of twenty three Stars.

CHAIN, an Instrument of hard Wire, distinguish'd into a hundred equal Parts, called Links, being used to measure Lengths in surveying of Land. They are of several Sorts; as

1. A Chain of a hundred Foot long, each Link being one Foot in Length, and at each tenth Foot there is a Plate of Brass, with a Figure engraved upon it, shewing readily how many Links are from the Beginning of the Chain; and for more Ease in reckoning, there is, or should be,

be a Brass Ring at every five Links, that is, one between every two Plates.

This Chain is most convenient for measuring of large Distances.

2. A Chain of sixteen Foot and a half in Length, and made so as to contain a hundred Links, with Rings at every tenth Link. This Chain is most useful in measuring small Gardens, or Orchards, by Perch or Pole Measure.

3. A Chain of four Poles or Perches in Length, (called *Gunter's Chain*;) which is sixty six Foot, or twenty two Yards; for each Perch contains sixteen Foot and a half. This whole Chain is divided into a hundred Links; whereof twenty five is an exact Perch or Pole; and for readily accounting, there is usually a remarkable Distinction by some Plate, or large Ring, at the End of twenty five Links; also at the End of every tenth Link it is usual to fasten a Plate of Brass with Notches in it, shewing how many Links are from the Beginning of the Chain; and this Chain, of all others, is the most convenient for Land-Measure.

If two Lengths for finding the Area of any Paralellogram, Triangle, &c. in Acres, Roods, and Perches, be given in Chains and Links; and if the Links be above ten, you set the Chains and Links down with a Prick of the Pen between them; but if under ten, a Cypher be set before the Links, and you multiply the two Lengths like decimal Fractions. Then if five

be cut off, the Figures to the Left Hand will be Acres.

If the five Figures cut off be multiplied by 4, and five Figures be again cut off towards the Right Hand from this last Product, the rest will be Roods.

Lastly, multiply the five Figures cut off at the second Multiplication by 40; and five Figures being cut off, the rest will be square Perches or Poles.

CHAIN-SHOT, is two Bullets, or rather Half-Bullets, fasten'd together with a Chain, their Use being chiefly to shoot down Masts, or cut the Rigging of a Ship, &c.

CHAMBER, is that Part of the Cavity of a great Gun, where her Carriage lies.

CHAMBRANLE, an Ornament in Masonry and Joiners Work, bordering the three Sides of Doors, Windows, and Chimneys, and is different according to the several Orders, and consists of three Parts, viz. the Top, called the *Traverse*, and the two Sides the *Ascendants*.

CHANDELIERS, in Fortification, are wooden Parapets made of two upright Stakes, about six Foot high, supporting divers Planks laid a-cross one another, or Bavins filled with Earth. They are made use of in Approaches, Galleries, and Mines, to cover the Workmen, and to hinder the Besieged from forcing them to quit their Labours. These differ from Blinds only in this, viz. that the former serve to cover the Pioneers before, and the latter to cover them over Head.

CHANEL, in the Ionick Capital, is a Part somewhat hollow under

the Abacus after the Listel; and lies upon the Echinus, having its Contours or Turnings on each Side to make the Voluta's.

CHAPTERS, in Architecture, are the Crowns, or upper Parts of a Pillar. Those that have no Ornaments, are called Chapters with Mouldings, such as the *Tuscan* and *Dorick*; the first whereof is the most simple, having its Abacus square, without any Mouldings; but the Abacus of the other is crowned with an Astragal, and three Annulets under the Echinus. All those that have Leaves and carv'd Ornaments, are term'd Chapters with Sculptures, and the first of them is the *Corinthian*, which is adorned with two Rows of Leaves; as also eight greater, and as many less Voluta's, plac'd under a Body called Tympanum. These are called usually Capitals.

CHAPTRELS, in Architecture, are the same with Imposts, and signify those Parts on which the Feet of Arches stand, and their Height or Thickness is commonly equal to the Breadth of the lower Part of the Key-Stone.

CHARACTERISTICK of a *Logarithm*. See *Index*, or *Exponent*.

CHARACTERS (MATHEMATICAL,) are certain Marks invented by Mathematicians, for avoiding Prolixity, and more clearly conveying their Thoughts to Learners, and are as follow;

$=$ is the Mark of Equality, (tho' *Descartes*, and some others, use this \propto .) and signifies that the Quantities on each Side of it are equal to one another; as,

$a=b$, signifies that a is equal to b .

$+$ in Algebra, is a Sign of real Existence of the Quantity it stands before, and is called an affirmative and positive Sign, because it implies the Quantity to be of a positive and real Nature, and is directly contrary to the following Sign $-$.

This affirmative Sign is also the Mark of Addition, and signifies that the Quantities on each Side of it are added together; as, if you see $a+b$, or $3+5$, it implies that a is added to b , or 3 added to 5, and is usually read a more b .

$-$ This is the Note of Negation, negative Existence, or Non-entity; and whenever it stands alone before any Quantity, it shews that Quantity to be less than nothing, and therefore such Quantities are called negative Quantities; as -5 is a negative Quantity, or 5 less than nothing.

This negative Sign is also the Mark of Subtraction; and signifies, that the Quantities on each Side of it, are subtracted from each other; as when you see $a-b$, it is read a less b , or b subtracted from a .

\propto , or \perp , is the Character expressing the Difference between two Quantities when it is not yet known, which is the greater of the two; for here the Sign $-$ cannot be used, because it always supposes the Quantities following to be always less than that going before it.

\times is the Sign of Multiplication; shewing, that the Quantities on each Side the same are to be multiplied by one another; as $a \times b$, or $AB \times CD$, is to be read

C H

* multiplied by b , or AB multiplied by CD .

\div is the Mark of Division, signifying, that the first of the two Quantities between it is divided by the latter; as $a \div b$, signifies that a is divided by b .

\odot is the Character of Involution, that is, of producing the Square of any Quantity, or of multiplying any Quantity into itself. In some Books of Algebra it is placed in the Margin, and shews, that the Step of the Equation, against which it stands, is to be multiplied into itself; or if it be a Square already, then to be raised to that Power that the Index set after the Character expresses.

ω is the Character of Evolution, that is, of extracting the Roots out of the several Powers, and is the Reverse of the last-mention'd Sign.

$::$ is the Mark of Geometrical Proportion disjunct, and is usually placed between two Pair of equal Ratio's; as $3 : 6 :: 4 : 8$ shews that 3 is to 6, as 4 to 8.

$\div\div$ is the Mark of Geometrical Proportion continu'd, and implies the Ratio to be still carried on without any Interruption; as 2, 4, 8, 16, 32, 64, $\div\div$.

$\sqrt{}$ is the Sign of Radicality, and shews, (according to the Index of the Power, that is set over or after it,) that the Square, Cube, or other Root, is extracted, or is to be so, out of any

Quantity; as, $\sqrt{16}$, or $\sqrt[2]{16}$, or $\sqrt{(2) 16}$, signifies the Square Root of 16, and $\sqrt[3]{16}$ is the Cube Root of 16.

\sqsupset , or \sqsubset , is the Character of greater. And,

C H

\sqsupset , or \sqsubset , the Mark of the lesser of two Quantities.

\parallel is the Sign for Parallels, and signifies that two Lines, or Panes, are equi-distant.

\triangle Triangle.

\square Square.

\square Rectangle.

\odot Circle, or the Sun.

\sphericalangle Equiangular, or Similar.

\triangle Equilateral.

\sphericalangle Angle.

\perp Right-Angle.

\perp Perpendicular.

$:::$ is the Mark for Arithmetical Progression.

$a. b = c. d$. This, by *Wolffius*, signifies, that a is to b , as c to d .

The Characters of the Seven Planets are,

♄ Saturn.

♃ Jupiter.

♂ Mars.

\odot Sol.

♀ Venus.

☿ Mercury.

☾ Luna.

The Characters of the Twelve Signs are,

♈ Aries.

♉ Taurus.

♊ Gemini.

♋ Cancer.

♌ Leo.

♍ Virgo.

♎ Libra.

♏ Scorpio.

♐ Sagittarius.

♑ Capricorn.

♒ Aquarius.

♓ Pisces.

The Characters of the Aspects are,

♌ Conjunction.

\triangle Trine.

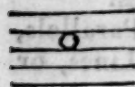
\square Quartile.

\ast Sextile.

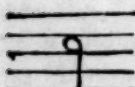
♌ Opposition.

C H

The chief Characters in Mu-
sic are,



Semibreve.



Minim.



Crochet.



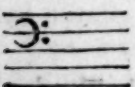
Quaver.



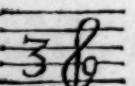
Semi-Quaver.



Demi-Quaver.



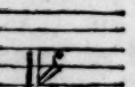
Base-Cliff.



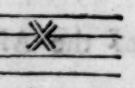
Treble-Cliff.



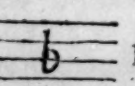
Tenor-Cliff.



Counter-Tenor-Cliff.



Sharp.



Flat.

C H



Shake.



Beat.



Common Time flow.



Common Time swifter.



Minim, or Bar-Rest.



Crochet-Rest.



Quaver-Rest.



Semi-Quaver-Rest.



Contradict.

CHARGED CYLINDER, is that Part of the Chase of a Great Gun, where the Powder and Ball are placed.

CHARLES'S-WAIN, seven Stars in the Constellation, called *Ursa Major*.

CHARTS, are Sea-Maps, for the Use of Seamen, having the Sea-coasts, Sands, Rocks, &c. depicted upon them, and are principally of two Kinds, viz. the Plain Chart, and *Mercator's*,
or

C H

or rather *Wright's*. Of these you will see more under the Words *Plain Charts*, and *Mercator's Chart*.

CHASE of a Gun, is its whole Length.

*CHAUSE-TRAPPE*s, or *Coltrops*, in Fortification, are Iron Instruments with four Spikes about four Inches long, made in such a Manner, that let them fall which Way soever, one Point, will always lie uppermost, like a Nail. They are usually scatter'd and thrown into Moats and Breaches, to gall the Horses Feet, and stop the hasty Approach of the Enemy.

CHEMIN de Ronds, in Fortification, is the Way of the Rounds, or a Space between the Rampart and the low Parapet under it, for the Rounds to go about the same, with the *Fausse Bray*.

CHEMISE, in Fortification, is a Wall that lines a Bastion, or any other Bulwark of Earth, for its greater Support; or it is the Solidity of the Wall from the Talus to the Stone-Row.

CHERSONESUS, in Geography, signifies the same with *Peninsula*, and is a Part of the Land enclosed all round with Water, except one narrow Neck, by which it joins to the main Land, that being called an Isthmus. Of these Chersones there are reckon'd up fourteen by *Verenius*, in his *Geography*, Chap. 8. Prop. 10. lib. 1.

CHEVAUX DE FRISE, or *Frise-land Horse*, is a large Joist, or Piece of Timber, about a Foot in Diameter, and ten or twelve in Length. There are driven a great Number of wooden Pins into the Sides thereof,

C H

about six Foot long, crossing one another, and having their Ends arm'd with Iron Points. Their principal Use is to stop up Breaches, or to secure the Avenues of a Camp from the Inroads both of Horse and Foot. These are much the same with Turnpikes.

CHILIADS, are the Tables of Logarithms; being so called, because they were at first divided into Thousands. Thus, in the Year 1624, Mr. Briggs published a Table of *Logarithms* for twenty *Chiliads* of absolute Numbers, and afterwards for ten *Chiliads* more, and then for one more, that is, for thirty one *Chiliads*.

And, in the Year 1628, *Adrian Ulacque* published this again with a Supplement of the *Chiliads* before omitted by Mr. Briggs; in all, making up a hundred and one *Chiliads*.

CHILIOGEN, a regular Plain Figure, of a thousand Sides and Angles.

CHORD, in general, is a Right-Line drawn from one Part of an Arch of a Circle to the other. But the

CHORD of an Arch, is a Right-Line joining the Extrems of that Arch.

1. A *Chord* is bisected by a Perpendicular drawn to it from the Centre of the Circle.

2. *Chords* in the same Circle, whose Arches are equal, are likewise themselves equal.

3. *Unequal Chords* in the same Circle, are not proportional to their Arches.

CHOROGRAPHY, is a particular Description of some Countrey; as, of *England*, *France*, or any Part of them, &c.

CHROMATICK, a Term in Musick, being the second of the three Kinds, which abounds in Semi-Tones, and contains only the least diatonical Degrees.

CHRONOLOGY, as it is commonly taken, is the Arithmetical Computation of Time for historical Uses; that thereby the Beginnings and Endings of Princes Reigns, the Revolutions of Empires and Kingdoms, Battles, Sieges, or any other memorable Actions, may be truly stated.

CHRONOSCOPE, the same as a *Pendulum*, to measure Time with.

CHRYSTALLVNE HEAVENS. These, in the *Ptolomaick System*, were two: Whereof one served them to explain the slow Motion of the Fixed Stars, and caused them (as they thought) to move one Degree Eastwards, in the same Space of seventy Years.

And the other helped them out in solving a Motion, which they called the *Motion of Trepidation*, or *Libration*; by which they imagined they swag from Pole to Pole.

CIMA, or *Cymaise*, is what we call, in *English*, an *Ogee*, *Ogive*, or barely *OG*; by which we mean a Moulding waved on its Centre, concave at the Top, and convex at the Bottom, and which makes the uppermost Member, and, as it were, the Cime or Top of large Cornices. Of these there are two Kinds: In the one, that Part which has the greatest Projecture, is concave, being term'd *Doucine*, or an *Upright Ogee*. In the other, the Convex Part has the greatest Projecture.

CINCTURE, in Architecture, is the same with *Apophygee*.

CIRCLE, is a plain Figure, comprehended under one Line only, to which Bounding Line all Right Lines, that are drawn from a Point in the Middle of it, are equal to one another. And it may be supposed to be generated thus:

If the Line *AB* be fastened at one End to the Point *A*, and the other Point or End *B* thereof be mov'd round, till it is return'd to the Place from whence it went, that Line, in thus moving, will describe a Circle;



and the Point or End *B*, the Circumference thereof: And the Point *A* will be the Centre.

1. The Area of any Circle is equal to a Rectangle, under the Diameter, and one Quarter of the Circumference.

2. The Diameter of a Circle is proportionate to the Circumference.

3. If the Diameter of a Circle be 1, the Circumference will be less than 3.1415926535897932384624338387950; but greater than the same Number, when the last Cypher is changed into Unity, as *Van Ceulen* shews, in *Libro de Circulo & Adscriptis*. But this Number being vastly too great for Practice, the Proportion of 100 to 314, in small Circles, or of 10000 to 31415, in large ones, will be pretty exact.

exact. But of all the Proportions in small Numbers, the following one of *Andrew Metius* is the most exact, viz. of 113 to 355; for if the Number 355, augmented by seven Cyphers, in order to bring out Decimals, be divided by 113, the Quotient, compar'd with *Van Caulen's* Numbers, will be found not to differ

from the Truth, $\frac{3}{10000000}$

If the Diameter of a Circle be 1, the true Area will be

$$\frac{1}{1} - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \frac{1}{11}$$

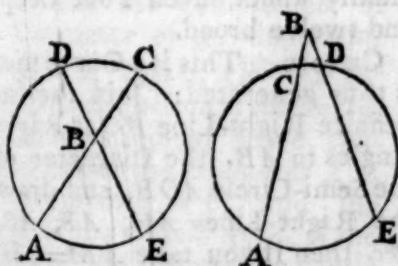
$$+ \frac{1}{13} - \frac{1}{15} + \frac{1}{17} - \frac{1}{19} + \frac{11}{21} \&c.$$

as is shewn by Mr. *Leibnitzs* in the *Acta Eruditorum*.

4. Circles are in the same Proportion to one another, as the Squares of their Diameters.

5. As 14 to 11, so is the Square of the Diameter of a Circle to its Area nearly.

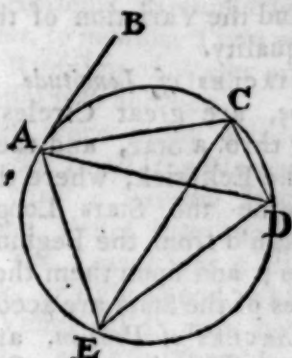
6. If two Right Lines, *AC*, *DE*, terminating in the Periphery of a Circle, do intersect each other in the Point *B*, either within the Circle, or (being continued) without it, as in the second Figure, then $AB \times BC = BE \times BD$.



7. The Angle *BAC* made by the Tangent *AB*, and the Chord *AC* is equal to any Angle *AEC*,

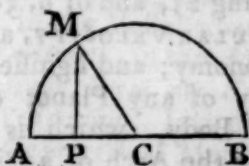
or *ADC*, in the Alternate Segment *AEC* of the Circle.

8. Let *ACDE* be a Quadrilateral Figure in the Circle, and the Lines *AD*, *EC*, the Diago-



nals, then $AC \times ED + AE \times CD = AD \times CE$.

CIRCLES of the higher Kind, are Curves, whercin $\overline{AP}^m : \overline{PM}^m :: P M : P B$. or else $\overline{AP}^m : \overline{PM}^m :: \overline{PM}^m : \overline{PB}^m$. supposing *MP* perpendicular to *AB*; whence, if $AP = x$, $PM = y$, $AB = a$, then is $y^{m+1} = ax^m - x^{m+1}$, or $y^{m+1} = a - x^m + x^m$ an Equation, expressing the Na-



ture of infinite Kinds of Circles; and so if $m=1$, then will $y^2 = ax - x^2$ be an Equation of a Circle of the first Kind; if $m=2$, then $y^3 = ax^2 - x^3$ will be an Equation of a Circle of the second Kind.

CIRCLES of Altitude. See *Almicanters*.

CIRCLES of Declination on the Globe, by some Writers, are the Meridians on which the Declination, or Distance from the E-

quator of any Planet or Star is accounted.

CIRCLE EQUANT, in the old Astronomy, is a Circle described on the Centre of the Equant; and the principal Use thereof is to find the Variation of the first Inequality.

CIRCLES of Longitude on the Globe, are great Circles, passing thro' a Star, and the Poles of the Ecliptick, where they determine the Stars Longitude, reckon'd from the Beginning of *Aries*; and upon them the Latitudes of the Stars are accounted.

CIRCLES of Position, are Circles passing thro' the Common Intersections of the *Horizon* and *Meridian*, and thro' any Degree of the Ecliptick, or the Centre of any Star or other Point in the Heavens; and are used for finding out the Situation or Position of any Star, &c.

CIRCULAR NUMBERS. These, by some, are such whose Powers terminate in their Roots themselves, as 5 and 6, whose Powers do end in 5 and 6; the Square of 5 being 25, and of 6, 36, &c.

CIRCULAR VELOCITY, a Term in Astronomy; and signifies, that Velocity of any Planet or revolving Body, which is measured by the Arch of a Circle.

CIRCUMAMBIENT. See *Ambient*.

CIRCUMFERENCE, is the outermost Bounding Line, or Lines, of any Plain Figure.

CIRCUMFERENTOR, an Instrument used in Surveying, being a large Box and Needle, fasten'd on to the Middle of a Brass Index, with Sights at each End of the Index.

CIRCUMGYRATION, is the Motion of any Body about a Centre.

CIRCUM-POLAR STARS, are such Stars, that being pretty near to our North Pole, do move round it; and in our Latitude never set, or go below the Horizon.

CIRCUMSCRIBED. A Figure, in Geometry, is said to be circumscribed, when either the Angles, Sides, or Planes of the Circumscrib'd Figure touch all the Angles of the Figure that is inscribed.

CIRCUMSCRIBED HYPERBOLA, is one that cuts its Asymptotes, and contains the Parts cut off within its own proper Space.

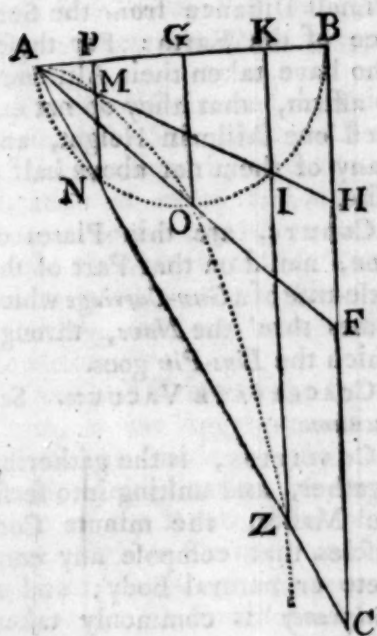
CIRCUMVALATION, or the *Line of Circumvalation*, in Fortification, is a Trench, border'd with a Parapet round about the Besieger's Camp, within Cannon-Shot of the Place, to hinder the Relief of the Besieged, and to stop Deserters. At the Distance of a Musket Shot it is commonly flank'd with Redoubts, and other small Works, or with Field-Forts raised upon the most eminent Posts. A *Line of Circumvalation* must never be drawn at the Foot of a rising Ground, for Fear lest the Enemy, having seized on the Station, should plant Cannon there, and so command the Line. This Line is usually about seven Foot deep, and twelve broad.

CISSOID. This is a Curve that is thus generated: Join the Indefinite Right-Line *BC* at Right Angles to *AB*, the Diameter of the Semi-Circle *AOB*, and draw the Right Lines *AH*, *AF*, *AC*, &c. then if you take $AM=IH$, $AO=OF$, $ZC=AN$, &c. the Points *M*, *O*, *Z*, &c. will form the Curve *AMOZ*, called, by *Diocles*, the Inventor thereof, a

Cissoid.

Cissoïd, being principally devised for finding of two mean Proportionals.

1. Draw the Right Lines, PM , KI , perpendicular to AB , then $AK=PB$, $PN=IK$.
2. The Lines AK , PN , AP , PM ; as also AP , PN , AK , KL .
3. The Line BC is an Asymptote to the *Cissoïd*.



4. The Cube of the Absciss AP is equal to a Solid made of the Square of the Semi-ordinate PM , into the Complement of the Diameter of the Generating Circle PB , that is, $AP^3 = PM^2 \times PB$, is the Equation of the Curve.
5. The *Cissoïdal* Space contained under the Diameter AB , the Asymptote BC , and the Curve of the *Cissoïd* AOZ , is the Triple of the Generating Circle ANB .

CIVIL DAY. See Day.

CIVIL YEAR, is the Legal Year, or Annual Account of Time,

which every Government appoints to be used within its own Dominions; and begins with us the 25th Day of *March*.

CLEPSYDERA, an Instrument of the Antients, particularly the *Egyptians*, to measure Time with, by the Running of Water out of one Vessel into another.

There were many Kinds of them: But in all, the Water ran gently thro' a narrow Passage from one Vessel into another; and in the Lower was a Piece of Cork, or light Wood, which, as the Vessel fill'd, rose up by Degrees, and so shew'd the Hour.

But in these Instruments there were two Inconveniencies: The first whereof was, that the Air, according to its different Temperature, as to Heat, Cold, Density, &c. had an Influence upon the Running of the Water, so as to make it measure Time unequally. And the second, which was yet greater, that the Water always ran slower out, according as its Quantity and Pressure in the Vessel abated.

Mr. Varignon, in the *Memoirs de l'Academie Royal des Sciences*, for the Year 1699, lays down a general Geometrical Method of making *Clepsydera's*, or *Water-Clocks*, with any Kind of Vessels, and with any given Orifices for the Water to run out of.

CLIFF, or *Cleff*, a Term in Musick, signifying a certain Mark, from the Position whereof the proper Places of all other Notes, in a Piece of Musick, are known. And there are four of them:

The First of these Cliffs is called *Faut-Cliff*, and belongs to the *Bass*; the *Cesaut-Cliff*, or *Tenor*.

Tenor-Cliff; the *Counter-Tenor*, or *Bemi-Cliff*; and the *Treble* or *Gammut-Cliff*.

CLIMACTERICAL YEARS, are certain observable Years, being supposed to be attended with some great Mutation of Life, or Fortune. These are the seventh Year; the twenty first, made up of three times seven; the forty ninth, made up of seven times seven; the sixty third, being nine times seven; and the eighty first, which is nine times nine; which two last are called the *Grand Climacterical Years*. *Aulus Gellius* says, this Piece of Stuff came from the *Chaldeans* first. And it is probable, that *Pythagoras* had it from them; who used to talk very much of the Efficacy of the Number Seven, being a Number he was extremely in Love with.

CLIMATE, is a Part of the Superficies of the Earth, bounded by two Circles, parallel to the Equator, so that the longest Day in that Parallel, nearest to the Pole, exceeds the longest Day in that Parallel, nearest to the Equator, some certain definite Part of Time, viz. half an Hour, till you come to Places situate nearly under the Arctick Circle; and a whole Hour, or even several Days, when you go beyond it.

The antient *Greek* Geographers reckoned only seven Climates from the Equator, towards the North Pole; and denominated them from some noted Place, thro' which the middle Parallel of the Climate pass'd. But the Moderns reckon up twenty four, as may be seen in *Verenius*, Page 319. *Prop.* 13. *Obap.* 25. *Lib.* 2.

CLOSE, in Musick. See *Cadence*.

CLOUDS, are a Congeries of Waters, drawn up from the Sea and Land into Vapours; which, when they are very nearly placed to one another, appear dense and thick; but when they are more remote, are clear and bright, and sometimes almost transparent.

Clouds swim in the Air at but a small Distance from the Surface of the Earth: For those, who have taken their Altitudes, do affirm, that they do not exceed one Mile in Height, and many of them not above half a Mile.

CLOUTS, are thin Plates of Iron, nail'd on that Part of the Axle-tree of a *Gun-Carriage* which comes thro' the *Nave*, through which the *Lins-Pin* goes.

COACERVATE VACUUM. See *Vacuum*.

COALITION, is the gathering together, and uniting into sensible Masses, the minute Corpuscles that compose any concrete or natural Body; and a *Coalescency* is commonly taken for the same.

COASTING, is that Part of Navigation, where the Places assigned are not far distant, so that a Ship may sail in Sight of Land, or within Soundings, between them.

CO-EFFICIENT of any generating Term in *Fluxions*, is the Quantity arising by the Division of that Term by the generated Quantity.

CO-EFFICIENTS, in Algebra, are such Numbers, or given Quantities, that are put before Letters, or unknown Quantities,

ties, into which Letters they are supposed to be multiplied, and so do make a Rectangle with the Letters; as here, $3a$, or $b x$, or $C x x$; where 3 is the Co-Efficient of $3a$, b , of $b x$, and C of $C x x$.

In a Quadratick Equation the Co-Efficient is, according to its Sign, either the Sum or Difference of its two Roots.

In any Equation the Co-Efficient of the second Term is always equal to the Sum of all the Roots, keeping their proper Signs.

The Co-Efficient of the third Term, is the Sum of all the Rectangles arising by the Multiplication of every two of the Roots, how many Ways soever those Combinations of Two's can be had; as three Times in a Cubick, six in a Biquadratick Equation, &c.

The Co-Efficient of the fourth Term, is the Aggregate of all the Solids made by the continual Multiplication of every three of the Roots, how often soever such a Ternary can be had; and so on, *ad infinitum*.

COFFER, in Fortification, is a hollow Lodgment a-cross a dry Moat, from six to seven Foot deep, and from sixteen to eighteen broad, the upper Part being made of Pieces of Timber, raised two Foot above the Level of that Moat; which little Elevation has Hurdles laden with Earth for its Covering, and serves as a Parapet with Embasures.

The Besieged generally make use of these Coffers to repulse the Besiegers, when they endeavour to pass the Ditch. And they differ only in Length from

the Caponnières, which are also something less in Breadth.

COLD, is one of the primary Qualities of Body, and is no more than the arriving of the minute and insensible Parts of any Body at such a State, as that they are more slowly or faintly agitated than those of our Fingers, or other Organs of feeling; for from this Effect we say a Body is cold.

COLLISION, is the Striking of one hard Body against another.

COLOUR, is that Quality of a Natural Body, whereby it is disposed to modify Light falling upon it, and striking upon the Organ of Sight, so as to produce that Sensation we call Colour.

Sir Isaac Newton was the first that, from Experiments on Prisms, found there was a great Deformity in the Rays of Light; and from thence found, that Colours are not Qualifications of Light, derived from Refractions or Reflections of Natural Bodies, but original and connate Properties, which in divers Rays are different; some Rays being disposed to exhibit a Red Colour, and no other; some a Green, and no other; and so of the others. Nor are there only Rays proper and particular to the more eminent Colours, but even to all their intermediate Gradations.

The least refrangible Rays are all disposed to exhibit a Red Colour; and the most refrangible ones, are those that express a Violet Colour.

There are two Sorts of Colours; the one Original and Simple, and the other compounded of these. The Original and Primary Colours are Red, Yellow,

low, Green, Blue, and a Violet Purple, together with Orange, Indigo, and an indefinite Number of intermediate Gradations.

The same Colours in *Specie* with these primary ones, may be also produced by Composition; for a Mixture of Yellow and Blue makes Green; of Red and Yellow makes Orange; of Orange and Yellowish Green makes Yellow. And generally, if any two Colours be mixed, which, in the Series of those generated by the Prism, are not too far distant from one another, they, by their mutual Alloy, compound that Colour which in the said Series appears in the Midway between them: But those that are situated at too great a Distance, do not do so. Orange and Indigo produce not the intermediate Green, nor Scarlet and Green the intermediate Yellow.

Whiteness is the usual Colour of Light, Light being a confused Aggregate of Rays, endued with all Sorts of Colours, as they are promiscuously darted from the various Parts of luminous Bodies; and of such a confused Aggregate is generated Whiteness, if there be a due Proportion of the Ingredients.

The Colours of all natural Bodies have no other Origin than this, *viz.* That they are variously qualified to reflect one sort of Light in greater Plenty than another; as Sir Isaac Newton has shewn in the *Philosophical Transactions*.

The Sensations of different Colours seem to arise from hence, That several Sorts of Rays do make Vibrations of several Big-

nesses, which, according to their Magnitudes, do excite Sensations of different Colours; much after the same Manner that the Vibrations of the Air, according to their several Bignesses, do excite Sensations of different Sounds.

And it is probable that the Harmony and Discord of Colours (for some Colours, as of Gold, Yellow, and Indigo, are agreeable to the Eyes, and others not) arise from the Proportions of these Vibrations propagated through the Fibres of the Optick Nerves into the Brain, just as the Harmony and Discords of Sounds arise from the Vibrations of the Air.

COLUMN, is a Kind of a round Pillar, composed of a Base, a *Fust*, or *Shaft*, and a *Capital*, and serves to support the *Entablement*.

Columns are different, according to the different Orders, being capable of a great Number of Variations, with regard to Matter, Construction, Form, Disposition, and Use.

The *Tuscan*, being the shortest and most simple, according to some, is seven Models long, comprehending its Base and Capital, and diminish'd a fourth Part of its Diameter.

The *Dorick*, seven and a half, or eight Diameters long, and its Base and Capital are somewhat more beautified with Mouldings.

The *Ionick* Column, nine Diameters long, and has its Capital set off with Voluta's, or curl'd Scrolls, differing in that Respect from others, as well as its Base, which is peculiar to it.

The *Corinthian*, the richest of all, being ten Diameters in Length, has two Rows of Leaves for the Ornament of its Capitals, with Stalks or Stems, from whence shoot forth small Voluta's.

The *Composite* Column, is also ten Diameters long, and its Capital is made like that of the *Corinthian*.

COLURES, are two great Circles, imagin'd to pass through the Poles of the World, one of them through the Equinoctial Points, *Aries* and *Libra*, and the other through the Solstitial Points, *Cancer* and *Capricorn*; they being call'd the Equinoctial and Solstitial Colures.

COMA-BERENICES, a Northern Constellation of Fix'd Stars.

COMBINATION of Quantities, is the Manner of finding how many different Ways they may be varied, or taken one and one, two and two, three and three, &c. as the Number of Combinations of three Quantities *abc*, two and two are three, viz. *ab*, *ac*, *bc*. If three Quantities are to be combin'd, and their Number is only three, as *abc*, then the Number of Combinations will be only one, viz. *abc*; and if there are four Quantities *abcd*, and three to be taken, then the Combinations will be four, viz. *abc*, *abd*, *bcd*, *acd*; and if the Number of Quantities to be combin'd be called *q*, and *u* be the Number of them to be taken, then the Number of Combinations will be

$$\frac{q-u+1}{1} \times \frac{q-u+2}{2} \times \frac{q-u+3}{3} \times \frac{q-u+4}{4} \times \frac{q-u+5}{5} \text{ \&c. until the Number to be added be}$$

equal to 4. For Example: Let the Number of the Quantities to be combin'd be 6, and let 4 be the Number of them taken; then the Number of the Combinations will be

$$\frac{6-4+1}{1} \times \frac{6-4+2}{2} \times \frac{6-4+3}{3} \times \frac{6-4+4}{4} = \frac{3}{1} \times \frac{4}{2} \times \frac{5}{3} \times \frac{6}{4} = 15.$$

The Number of all the possible Combinations beginning from the Combinations of every two, will be $2^q - q - 1$; as when the Number of Quantities be 5, then the Number of the possible Combinations will be $2^5 - 6 = 26$.

If *u* represents any Number of Quantities, then will

$$\frac{u^{u+1} - u}{u-1}$$

express the possible Number of all the Variations;

$$\text{as if } u=4, \text{ then } \frac{4^5 - 4}{4-1} = \frac{1020}{3} = 340.$$

COMBUST, a Term in Astronomy. When a Planet is not above eight Degrees and thirty Minutes distant from the Sun, either before or after him, he is said then to be combust, or in Combustion.

COMETS, are Stars, most of which have Tails, suddenly arising in the Heavens, and appearing for some Time, do afterwards again disappear; and all the Time that they are seen, they, like the Planets, move every Day some certain Length in their proper Orbits.

Aristotle, and his Followers, supposed that Comets were only Meteors or Exhalations, set on fire in the highest Region of the

the Air, below the Moon. And this Opinion had so far prevail'd, that no Body thought it worth while to write concerning the uncertain Motions of a Vapour or Exhalation; and so nothing certain about the Motions of Comets can be found transmitted from them to us.

But *Seneca*, the Philosopher, from the Consideration of the Phænomena of two remarkable Comets of his Time, made no Scruple to place them among the Celestial Bodies, and believed them to be Stars of equal Duration with the World, tho' he could not tell the Laws of their Motion; but prophesied that After-Ages would find out in what Parts of the Heavens the Comets wander'd, what and how great they were.

Tycho Brahe, in the Year 1577, first observed a Comet, that then appeared to have no *Diurnal Parallax*, and consequently was not only no Areal Vapour, but also much higher than the Moon. And afterwards *Kepler* found that the Comets moved freely thro' the Orbits of the Planets, with Motions very little different from right-lin'd ones. And *Hewelius* embracing the same right-lin'd Motion of the Comets, observ'd many of them; but complain'd, that his Calculations did not agree to the Matters of Fact in the Heavens; and was aware that the Path of a Comet was bent into a Curve-Line towards the Sun.

But from the accurate Observations of the great Comet of the Year 1680, *Sir Isaac Newton* shews, in his *Principia*, that Comets move in Conick Sections,

having their Foci in the Centre of the Sun, and by Rays drawn to the Sun, do describe Area's proportional to the Times; and so, if Comets return in their Orbits, the Orbits are Ellipses, and the periodick Times are to the periodick Times of the Planets in the sesquiplicate Ratio of the principal Axes. But the Orbits of Comets are so near to Parabola's, that Parabola's may be taken instead of them, without any sensible Error.

The Planes of the Orbits of Comets are always inclined to the Plane of the Ecliptick; and some move from East to West, some from West to East, some from North to South, and some from South to North.

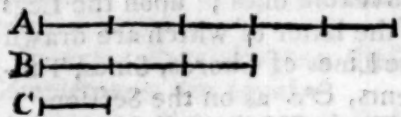
The Bodies of Comets, according to *Sir Isaac Newton*, are solid, compact, fix'd and durable, like the Planets, and shine by the Light of the Sun-Beams reflected from them: And the Tail of a Comet is only a long and very thin Smoak, or Train of Vapours, which the Head of the Comet emits from it, by being vastly heated by the Sun; and always appears on that Side of the Comet opposite to the Sun.

COMMA, a Term in Musick, being the ninth Part of a Tone, or the Interval whereby a Semi-Tone, or a perfect one exceeds the imperfect. This is used only in the Theory of Musick, to shew the exact Proportion between Concorde.

COMMANDING GROUND, in Fortification, is such as overlooks any Post, or strong Place, and is of three Sorts: First, a Front Commanding Ground, which is an Height opposite to the Face
of

of the Post, which plays upon its Front. Secondly, a Reverse Commanding Ground, which is an Eminence that can play upon the Back of any Place, or Post. Thirdly, an Enfilade Commanding Ground, which is an high Place, that can, with its Shoot, scour all the Length of a Straight Line.

COMMENSURABLE MAGNITUDES, are such as are measur'd by one and the same Common Measure; as, if the Magnitude



A, *B*, the one 3, and the other 3, be measur'd exactly by the Magnitude *C*, supposed to be 1, then the Magnitudes *A* and *B* are called *Commensurable*.

COMMENSURABLE NUMBERS, whether Integers or Fractions, are such as have some other Number which will measure or divide them without any Remainder: Thus, 4 and 6, or $\frac{1}{2}$ and $\frac{1}{4}$ are Commensurable.

COMMENSURABLE in Power. Right-Lines, by *Euclid*, are said to be Commensurable in Power, when their Squares are measur'd by one and the same Space or Superficies.

COMMENSURABLE SURDS, are such Surds, that being reduc'd to their least Terms, become true figurative Quantities of their Kind; and are therefore as a rational Quantity to a rational one.

COMMON AXIS, in Opticks. See *Axis*.

COMMON DIVISOR, is that Number that exactly divides any

two other Numbers, without a Remainder.

COMMON MEASURE, is such a Number that exactly measures two or more Numbers without a Remainder.

COMMON MEASURE (*Greatest*), of two or more Numbers, is the greatest Number that can measure them; as, 4 is the greatest Common Measure of 8 and 12.

COMMON RAY, in Opticks, is a Right Line drawn from the Point of Concurrence of the two optical Axes, thro' the Middle of the Right Line, passing thro' the Centre of the Pupil of the Eye.

COMPARTITION, in Architecture, is the useful and graceful Distribution of the whole Ground-plot of an Edifice into Rooms of Office, Reception, or Entertainment, &c.

COMPARTMENT, in Architecture, is a peculiar Square, or other figur'd Space, (for an Inscription, &c.) mark'd out in some ornamental Part of a Building.

COMPASS, in Navigation, is a Circle, or Chard of Past-board, divided into thirty two equal Parts, called *Rhumbs*, or *Points*, representing the thirty two Winds, with the initial Letters of their Names set to them, having a touched Needle or Wire fix'd to it underneath, and in its Centre a Brass Cell, or Conical Cavity, by Means of which it hangs on an erect Pin, set up in the Centre of another such Chard, fitted in a Wooden or Brass Box, with Jambols, or Brass Hoops; so that during the Motion of the Ship, the Chards may be nearly Horizontal, and the Flower-de-Luce of the

the upper Chard will always point towards the North.

This Instrument, tho' it be subject to Accidents, is of great Use in Navigation; and all the considerable Discoveries of Countries are owing to the same.

The Invention of it, by some, is attributed to one *John Goia*, of *Amalphi*, in *Campania*, in the Kingdom of *Naples*; who made the Chard thereof to consist only of eight Points, viz. the four Cardinal, and four Collateral ones. Others say it was the Invention of the People of *China*. And *Gilbert*, in *Libro de Magnete*, affirms, That *Paulus Venetus* brought it first into *Italy* in the Year 1260, having learned it from the *Chinese*. And *Ludi Vertomannus* affirms, That when he was in the *East-Indies*, about the Year 1500, he saw a Pilot of a Ship direct his Course by a Compass, fasten'd and framed as those that now are commonly used.

And Mr. *Barlow*, in his *Navigator's Supply*, Anno 1597, says, That in a personal Conference with two *East-Indians*, they affirmed, that instead of our Compass, they use a Magnetical Needle, of six Inches, and longer, upon a Pin in a Dish of white China Earth, filled with Water; in the Bottom whereof they have two Cross-Lines for the principal Winds, the rest of their Divisions being left to the Skill of their Pilots. Also, in the same Book, he says, That the *Portuguese*, in their first Discovery of the *East-Indies*, got a Pilot of *Mabinde*, that brought them from thence in thirty three Days within Sight of *Calicut*.

COMPASS DEALS, are small Horizontal Dials, fitted in Brass or Silver Boxes for the Pocker, and are set North and South, by Means of a Compass, or Touched Needle belonging to them.

COMPASSES of Proportion, or Proportional Compasses, are such that have two Legs, but four Points, which, when opened, are like a Cross, not having the Joint at the End of the Legs, as common Compasses: And some of these have fix'd Joints, others moveable ones; upon the Legs of the latter of which are drawn the Lines of Chords, Sines, Tangents, &c. as on the Section.

Their Use is to divide Right-Lines and Circles into equal Parts, or to perform other Operations of the Sector at one Opening of them.

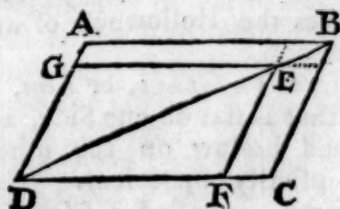
COMPLEMENT of any Arch or Angle, to any other Arch or Angle, (as of ninety Degrees, a hundred and eighty Degrees, &c.) is the Arch or Angle which, together with that Arch or Angle, makes up ninety Degrees, or a hundred and eighty Degrees, &c.

COMPLEMENT of the Course, in Navigation, is the Number of Points the Course wants of ninety Degrees, or eight Points, that is, of one Fourth of the Compass.

COMPLEMENT of the Courtain, in Fortification, is that Part of the Courtain which (being wanted) is the Demi-Gorge.

COMPLEMENT of the Line of Defence, is the Remainder of the Line of Defence after the Angle of the Flank is taken away.

COMPLEMENTS in a *Parallelogram*, are the two small *Parallelograms AGE, FCE*, made



by drawing two Right Lines *GE, FC*, through the Point *E* in the Diagonal, parallel to the Sides *AB, BC*, of any *Parallelogram ABCD*.

In every *Parallelogram* these Complements are equal.

COMPOSED NUMBERS, are such that some Number besides Unity can measure; as 12, which is measur'd by 2, 3, 4, and 6.

COMPOSED NUMBERS, between themselves, are such that have some common Measure besides Unity; as 12 and 15, which may be both measur'd by 3.

COMPOSITE Order, is the fifth Order of Architecture; and is so called, because its Capital is composed of two Rows of Leaves proper to the *Corinthian* Order, and the Voluta's of the *Ionick*. This Order is sometimes called the *Italick*, or *Roman*, as having been first invented by that People. Its Column is ten Diameters in Height, and there are always Dentiles or simple Modillions to its Cornice.

COMPOSITION, is the reverse of the Analytick Method, or of Resolution. It proceeds upon Principles self-evident, on Definitions, Postulatus, and Axioms, and a previously demonstrated Series of Propositions, Step by Step, till it gives a clear

Knowledge of the Thing demonstrated. This is what they call the Synthetical Method, and is used by *Euclid*, *Apollonius*, and most of the Antients.

COMPOSITION of Proportion. If there be two Ratio's, and it shall be as the Antecedent of the first Ratio to its Consequent, so is the Antecedent of another to its Consequent. Then, by Composition of Proportion, as the Sum of the Antecedent and Consequent of the first Ratio, to the Antecedent or Consequent of the first, so is the Sum of the Antecedent and Consequent of the second, to the Antecedent or Consequent of the second: As, if $A : B :: C : D$. then, by Composition, $A+B : A(B) :: C+D : C(D)$

COMPOUND Interest, is that Part of it that treats of the Money produced from any Principal, and its Interest put together, as the Interest of that Principal becomes due, that is, finding the new Principal that is still created by the Increase of the growing Money at every Payment, or rather at the Times when the Payments become due, is called *Compound Interest*, or *Interest upon Interest*.

If R be the Amount for one Pound of one Year, then R^2 will be the Amount for two Years, R^3 for three Years, R^4 for four Years, &c.

As 1*l.* is to its Amount for any given Time, so is any proposed Principal or Sum to its Amount for the same Time.

COMPOUND MOTION, is that which is produced by several Forces conspiring together; and Forces are said to conspire,

C O

spire, when the Direction of the one is not contrary to the Direction of the other; as, when the Radius of a Circle moves about the Centre, and at the same Time a Point be conceived to go forwards along it.

Whence every Curv'd-lin'd Motion is a Compound Motion.

COMPOUND QUANTITIES, in Algebra, are such as are connected together by the Signs $+$ and $-$, and are expressed by the same Letters more than once, or else by the same Letters unequally repeated; as, $a+b-c$, and $bb-b$ are Compound Quantities.

COMPOUND RATIO. The Ratio that the Product of the Antecedents of two or more Ratio's has to the Product of their Consequents, is called a *Compound Ratio*: So 6 to 72 is in a Ratio compounded of 2 to 6, and 3 to 12.

The Exponent of a Compound Ratio is equal to the Product that the Exponents of simple Ratio's produce.

As if m be the Exponent of the Ratio $\frac{A}{B}$, and n of $\frac{C}{D}$; then will mn be the Exponent of $\frac{AC}{BD}$, or of the Ratio compounded of $\frac{A}{B}$ and $\frac{C}{D}$.

If there are never so many Quantities, A, B, C, D, E, F , &c. the Ratio of the first A to the last F , is compounded of the Ratio's of the Quantities being between the Extremes, viz. $\frac{A}{B}, \frac{B}{C}, \frac{C}{D}, \frac{D}{E}, \frac{E}{F}$ &c.

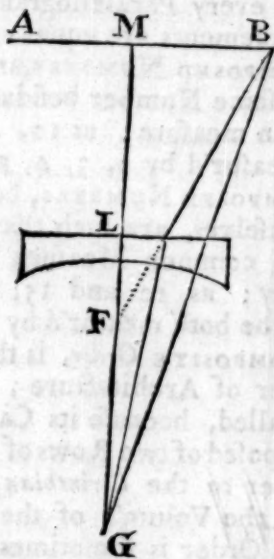
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COMPRESSION, is the squeezing of a Mass of Matter into a lesser Bulk.

CONCAVE, or *Concavity*. This signifies the Hollowness of any Thing.

CONCAVE-GLASS, or *Lens*, is one that is flat on one Side, and ground hollow on the other, but usually Spherical. This, by some, is called a *Plano-Concave*, and if the Glass be Concave on both Sides, it is called a *Double-Concave*.

The Object AB , seen through a Concave-Glass, will appear in



an erect Posture, but diminish'd in a compounded Ratio of $FL \times GM$ to $GL \times FM$, supposing F to be the Point to which the Ray BC tends unrefracted, and G the Eye.

The Rays of the Sun, in their Passage through a Concave-Glass, are weakened after the Refraction; and so the Effect of Concave-Glasses is contrary to that of Convex ones.

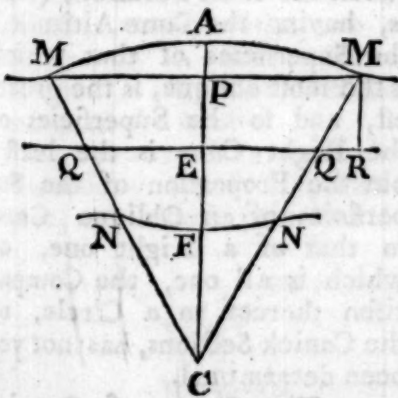
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The confused Appearance of a Point through any Concave-Glass, proceeds from the two great Divergency of those Rays that fall on the Eye; and so because the more remote the Eye is from the Glass, the less will the Rays diverge, therefore, the further the Eye is from a Concave-Glass, the more distinct will the Appearance of any Object through it be, tho' it will be more faint.

The apparent Place of Objects, seen through Concave-Glasses, is always brought nearer to the Eye; and this is the Reason why they help short-sighted Persons, or such as can see nigh Objects only distinctly.

CONCENTRICK FIGURES, are such as have the same common Centre.

CONCHOID, is the Name of a Curve, given to it by its Inventor *Nicomedes*, and is thus generated;



Draw the Right Line QQ , and AC perpendicular to it in the Point E , and from the Point C draw many Right Lines, CM cutting the Right Line BD in Q , and make $QM = QN$, $AE = EF$: Then the Curve, where-

in are the Points M , is called the first Conchoid; and the other, wherein are the Points N , the second; the Right Line QQ being the Directrix, and the Point C the Pole. And from hence it will be very easy to make an Instrument to describe the Conchoid.

The Line QQ is an Asymptote to both the Curves, which have Points of contrary Fluxion.

If $QM = AE = a$, $EC = b$, $MR = EP = x$, $ER = PM = y$; then will $a^2 b^2 - 2a^2 bx + a^2 x^2 = b^2 x^2 - 2bx^3 + x^4 + x^2 y^2$, express the Nature of the second Conchoid; and $x^4 + 2bx^3 + y^2 x^2 + b^2 x^2 = a^2 b^2 + 2a^2 bx + a^2 x^2$, the Nature of the first; and so both these Curves are of the third Kind.

There may be other Kinds of Conchoids produced by making $CE : CQ :: QM : AE$ or $CE^n : CQ^n :: QM^n : AE^n$.

Sir *Isaac Newton*, in the latter Part of his *Algebra*, tells us, That this Curve was used by *Archimedes* and other Antients in the Construction of solid Problems; and he himself prefers it before other Curves, or even the Conick Sections in the Construction of Cubick and Biquadrastick Equations, on account of its Simplicity and easy Description, shewing therein the Manner of their Construction by Help of it.

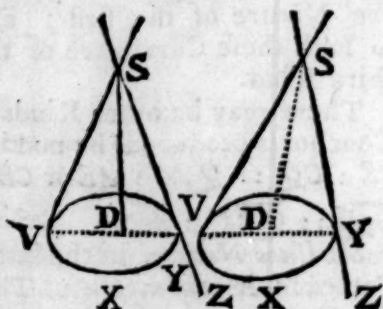
CONCRETE NUMBERS, are those that are applied to express or denote any particular Subject; as 3 Men, 2 Pounds, &c. Whereas, if nothing be connected with the Number, it is taken abstractly or universally;

as 4 signifies only an Aggregate of four Unites, be they Men, Pounds, or what you please.

CONCURRING, or CONGRUENT FIGURES, in Geometry, are such, as being exactly laid upon one another, will exactly meet, and cover one another; and therefore it is a received Axiom, that Plane Figures, exactly covering one another, are equal among themselves.

CONDENSATION, is when any Mass of Matter is thrust into a less Bulk than it was before, by Means of Cold.

CONE. If the immoveable Point *S* be taken without the Plane, in which the Circle



VXY is describ'd; and if the indefinite Right Line *SZ*, drawn through that Point, moves quite round the Circumference of that Circle, then that Line will generate a Superficies, and the Solid contain'd under the Base, or Circle *VXY*; and that Part of the Superficies between the Base and the Vertex, or Point *S*, is called a Cone; and if the Line *SD*, or Axis be at Right Angles to the Plane of the Base, the Cone is called a Right one; but if it be Oblique, as in the second Figure, the Cone is called an Oblique or Scalene one.

Euclid, in his Eleventh Book, gives a Definition of a Cone that is not general, it being only of a Right-lined Cone; for he says a Cone is produced by the Revolution of the Plane of a Right-angled Triangle, about the perpendicular Leg remaining at rest.

1. Every Cone is one third Part of the Cylinder, having the same Base and Altitude; and so the Solidity of any Cone is equal to the Area of its Base, multiplied into one third Part of its Altitude.

2. All Cones standing upon the same Base, and being between the same Parallels, are equal to one another.

3. The Superficies of a Right Cone, not taking in the Base, is equal to a Triangle, whose Base is the Periphery, and Altitude the Side of the Cone.

4. Of all Cones standing upon the same Base, and being between the same Parallels, (that is, having the same Altitude,) the Superficies of that which is the most oblique, is the greatest, and so the Superficies of the Right Cone is the least; but the Proportion of the Superficies of an Oblique Cone to that of a Right one, or which is all one, the Comparison thereof to a Circle, or the Conick Sections, has not yet been determined.

5. The Centre of Gravity of a Cone is three Fourths of the Axis distant from the Vertex.

CONES of the higher Kind, are such, whose Base are Circles of the higher Kind.

CONE of Rays, in Opticks, are all the Rays that fall from any

any Point of an Object upon the Surface of any Glass, having its Vertex in that Point, and the Glass for its Base.

CONFUSED VISION. See *Vision*.

CONGE, a Term in Architecture. See *Apophygee*.

CONGRUITY of Geometrical Figures. See *Concurring*.

CONICK SECTIONS, are Curves made by cutting a Cone by a Plane, and leaving out the Circle and Triangle; are three in Number, viz. the Ellipsis, Hyperbola, and Parabola.

These Curves being all those of the second Kind, or Order, are of vast Use in Mathematicks. See more of them under the Words Ellipsis, Hyperbola, and Parabola.

CONJUGATE AXIS of an Ellipsis, is the shortest of the two Axes; and in the Hyperbola it is a mean Proportional between the Transverse Axis and the Parameter.

CONJUGATE DIAMETERS of an Ellipsis, or Hyperbola, are two Diameters so drawn, that one of them is parallel to the Ordinates of the other.

CONJUGATE HYPERBOLA'S. If there be two opposite Hyperbola's, *Aa*, *am*, whose principal Axis



is the Line *Aa*, and Conjugate Axis the Line *Bb*; and if there be two other Hyperbola's, whose

Principal Axis is the Line *Bb*, and Conjugate one the Line *Aa*, then these four Hyperbola's are called *Conjugate Hyperbola's*, the two former Opposite ones, being Conjugates to the latter.

CONJUNCTION, in Astronomy, is the Meeting of the Stars and Planets in the same Degree of the Zodiack, and is either *Apparent* or *True*.

CONJUNCTION *Apparent*, is when a Right Line supposed to be drawn through the Centres of of the two Planets, does not pass through the Centre of the Earth, but through the Eye.

CONJUNCTION *True*, is when that Right Line, being produced, passes through the Centre of the Earth.

CONOID, is a Solid produced by the Circumvolution of a Section of the Cone about its Axis, and may be either a

CONOID *Epileptical*, when made by an Ellipsis, and then is more commonly called a Spheriod; and if the Revolution be made about the *Latus Transversum*, it forms an oblong Spheriod; but if round the Conjugate Axis, a *Prolate* or *Oblate* one,

CONOID *Hyperbolical*, when made by an Hyperbola.

CONOID *Parabolical*, when it is produced by the Parabola revolving about its Axis.

1. The Solidity of an Epileptical Conoid, or Spheriod, is to the Solidity of its Circumscribing Cylinder, as 2 to 3; and the Superficies thereof is comparable with the Conick Sections.

2. The Solidity of the Hyperbolical Conoid is to the Solidity of the Circumscribing Cylinder

linder, as 3 to 10; and its Surface is comparable with the Conick Sections.

3. The Solidity of the Parabolical Conoid is, to the Solidity of its Circumscribing Cylinder, as 1 to 2.

4. If a be equal to the Transverse Axis of the Hyperbola, generating a Conoid, and x be the Height of the Conoid, or the Absciss of the Hyperbola, then, as $6a + 4x$ is to $4a + 3x$, so is x to the Distance of the Centre of Gravity of the Hyperbolical Conoid from the Vertex.

5. If r be equal to the Semi-Diameter of the Base of a Parabolical Conoid, and a the Height, and p the Parameter of the generating Parabola, then will the whole Superficies of the Conoid be $= 4pr^2 + pa^2 \times 4r^2 + a^2$

$$12ar - \frac{1}{2}pa^2r.$$

6. The Centre of Gravity of a Parabolical Conoid is distant from its Vertex $\frac{2}{3}$ of its Height.

7. The Sections of all Conoids, made by Planes cutting them, will be the same as the Sections of a Cone.

CONSCRIB'D, the same with Circumscrib'd. Which see.

CONSECTARY, is a Deduction, or Consequence, drawn from a preceding Proposition; and is the same with Corollary.

CONSEQUENT, in Mathematicks, is the latter of the two Terms of a Ratio: As suppose the Ratio be of A to B , then B is said to be the Consequent.

CONSOLE, in Architecture, is an Ornament cut upon the Key of an Arch, which has a Projecture or Jetting, and, upon Occasion, serves to support little Cornices, Busts, and Bases.

CONSONANCE, in Musick, is the Agreement of two Sounds, the one Grave, and the other Acute, being compounded together by such a Proportion of each, as proves agreeable to the Ear.

An Unison is the first Consonance, an Eighth the second, a Fifth the third; and then follows the fourth, and the Thirds and Sixths, Major and Minor. There are other Consonances, being the Doubles, or other Repetitions of the former. But there can be only seven or eight simple Consonances, the perfect ones being the Unison, Eighth, and Fifth, with their Compounds.

CONSTANT QUANTITIES, are such that remain the same, while others increase, or decrease. So the Semi-Diameter of a Circle is a Constant Quantity; for while the Absciss and Semi-Ordinates increase, it remains the same.

CONSTELLATION, or *Asterism*, is a Company of Fixed Stars, imagined (by the Antients) to represent the Name of something, and commonly called by the Name of that Thing. Of these there are forty eight, twenty three being Northern, and twenty five Southern ones.

Some Zealots have been so vain, as to attempt the Changing the Names of the Constellations, in giving them Appellations taken from the Scriptures, as Venerable Bede, and Julius Schillerus, who called, for Example, Aries, Peter; Taurus, Andrew; Andromeda, the Sepulchre of Christ; Hercules, the Wise Men coming from the East; the Great Dog, David, &c.

And Weigelius, a *quendam* Professor of Mathematick at Geneva

neva, in his *Cælum Heraldium*, has transferred the Chief Princes of *Europe* into the Heavens; as the *Great Bear* is changed into the Elephant of the Kingdom of *Denmark*, &c.

But this Boldness ought not to be approved of; which, instead of being useful, will beget Confusion in Astronomy: For the Names and Signs of the Antients are to be retained, not only because there cannot be better ones put for them, but that the Writings of Astronomers, that have been as yet publish'd, may be understood, and the Observations of the Antients compared with those of the Moderns.

CONSTIPATION, is when the Parts of any Body acquire a closer Texture than what they had before.

CONSTRUCTION, is the Crowding the Parts of any Body close together, in order to Condensation,

CONSTRUCTION of Equations, in Algebra, is the Finding the unknown Quantities or Roots of an Equation, either by Straight Lines, or otherwise.

1. All simple Equations, or those of one Dimension, may be constructed, by resolving the Fractions that the unknown Quantity is equal to, into proportional Terms.

2. All Quadraticks may be constructed by Means of a Right Line, and a Circle.

3. All Cubick or Biquadratic Equations may be constructed by Means of a Circle, or a given Parabola or Hyperbola.

4. All Equations may be constructed by the Interlection of two Loci. And the most simple

Loci, that will construct an Equation, may be found thus: Extract the Square Root of the highest Power of the unknown Quantity, and if there be no Remainder, then each of the two Loci must be of the same Number of Degrees as there are Unites contained in that Square Root.

But if there be a Remainder, the same is equal, less, or greater than the Square Root: If it be equal, or less, the Degree for one of the Loci will be the Root itself; and for the other, that Root *plus* Unity. If the Remainder be greater than the Root, then the Degree of both the Loci shall be the Root *plus* Unity.

As, if it were required to find the most Simple Loci that will construct an Equation of 12 Dimensions, the Square Root thereof is 3, and the Remainder is 3; whence, a Locus of the third Degree, and another of the fourth, will construct the Equation. Moreover, to find the two most Simple Loci that will construct an Equation of 37 Dimensions, having extracted the Square Root of 37, which is 6, the Remainder will be 1, being less than 6; therefore one of the Loci must be of the 6th, and the other of the 7th Degree. And these Loci will do for Equations of 38, 39, 40, 41, and 42 Dimensions.

CONSTRUCTION, in Geometry, is the Drawing such Lines as are previously necessary for the making any Demonstration appear more plain and undeniable.

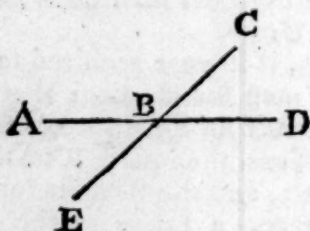
CONTACT, is when one Line, Plane, or Body, touches another; and the Parts, that do thus touch,

touch, are called the *Points*, or *Places of Contact*.

CONTIGUITY, is only the Surface of one Body's touching that of another. But *Continuity* is the immediate Union of the Parts which compose any Natural Body; so that one cannot tell where one begins, and another ends.

CONTIGUOUS ANGLES, in Geometry, are such as have one Leg common to each Angle; and are sometimes called *Adjoining Angles*.

As the Angles *ABC*, *CBD*; *CBD*, *DBE*; *DBE*, *EBA*, are Contiguous Angles.



The Sum of any two Contiguous Angles is always equal to two Right Angles.

CONTINENT, in Geography, is a great Extent of Land, comprehending several Regions and Kingdoms; and which is not interrupted or separated by Seas. Of these there are reckon'd four, viz. *Europe*, *Asia*, *Africa*, and *America*.

CONTINGENT LINE, the same with *Tangent Line*. This Line, in Dialling, is supposed to arise from the Intersection of the Plane of the Dial and Equinoctial; and is so called, because it is a Tangent to a Circle, drawn upon the Plane of the Dial, and is at Right Angles to the Substilar Line.

CONTINUAL PROPORTIONALS. If there be such a Series of Quantities, that the first is in the same Proportion to the second, as the second to the third, and the third to the fourth, and the fourth to the fifth, and so on, they are called *Continual Proportionals*.

CONTINUED QUANTITY, is that whose Parts are inseparably joined and united together, so that you cannot distinguish where one begins and another ends.

CONTRA-MURE, in Fortification, is a little Wall built before another Partition-Wall, to strengthen it, so that it may receive no Damage from the adjacent Buildings.

CONTRATE-WHEEL, is that Wheel in Watches which is next to the Crown, whose Teeth and Hoop lie contrary to those of the other Wheels; from whence it takes its Name.

CONTRAVALLATION, or the *Line of Contravallation*, in Fortification, is a Trench guarded with a Parapet, and usually cut round about a Place by the Besiegers, to secure themselves on that Side, and to stop the Sallies of the Garison. It is without Musket-Shot of the Town; so that the Army forming a Siege, lies between the Lines of *Circumvallation* and *Contravallation*.

CONTRE-QUEVE D'YRONDE, a Term in Fortification, the same as *Counter-Swallows-Tail*.

CONVERGING (or Convergent) RAYS, in Opticks, are those Rays that, issuing from divers Points of an Object, incline towards one another, till at last they meet, and cross, and then become *Diverging Rays*; as, the Rays

Rays AB , CB , do converge till they come to the Point B , and

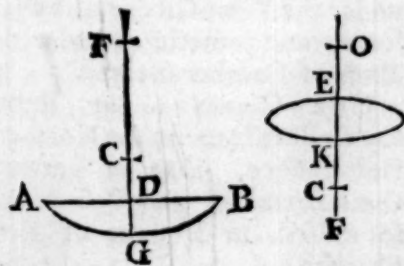


then they diverge, and run off from each other in the Lines BD , BE .

CONVERSE. In Mathematicks one Proposition is called the Converse of another, when, after a Conclusion is drawn from something *supposed* in the Converse Proposition, that Conclusion is *supposed*; and then that, which in the other was *supposed*, is now drawn as a Conclusion from it. As thus; When two Sides of a Triangle are equal, the Angles under their Sides are equal; and on the Converse, if those Angles are equal, the two Sides are equal.

CONVEX-GLASS, or *Lens*, is a Glass that has one of its Surfaces plain, and the other spherically Convex. This, by some, is called a *Plano-Convex*.

1. If AGB be a Convex Glass, and F the Focus of Parallel



Rays, and C the Centre of the Glass, then will $FD = 2 CG$ —

$\frac{2}{3}GD$. And so if two Thirds of the Thickness GD be so small, as to be neglected, as often happens, then will Parallel Rays unite at the Distance of the Glass's Diameter, whether the flat or convex Side of the Glass be turned towards the luminous Body.

2. If KE be a Glass Convex both Ways, or a Double Convex, and C , O , be the Centres of the Convexities, and F the Focus of Parallel Rays falling upon the Glass, then will $KO + CE : 2OE :: KO : FK$.

3. The Focus of Diverging Rays is farther distant from the Glass than the Focus of Parallel Rays; and the Distance of the Focus in the former Case is greater, or less, according to the greater or less Distance of the radiating Point.

4. If an Object be in the Focus of a Convex Glass, and the Eye on the other Side of the Glass, the Object will appear erect and distinct.

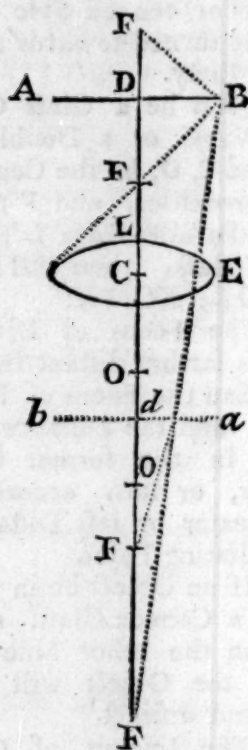
5. The Images of Objects, opposite to a *Lens*, any how Convex, are distinctly pointed and inverted in the Focus thereof.

6. The Image ba of an Object AB , delineated in the Focus d , of a Convex Glass, is to the Object itself, as to Diameter, in the Ratio of the Distance of the Image Cd , to the Distance of the Object CD .

7. If the Eye O be in the Axis of a Convex Lens, but between the Focus d and the Lens, the Object will appear in an erect Position, but augmented, as to Diameter, in a Ratio compounded of the Distance of the Point F , to which the Ray BE tends unrefracted from the Lens

EL ,

EL, to the Distance of the Eye *OL*, from the same ; and of *OD*, the Distance of the Object *AB*, from the Eye to the Distance *FD* of the same Object, from the Point



to which the Rays tend unrefracted, that is, $FL : OD :: OL : FD$.

8. And if the Eye *O* be beyond the Focus, the Point *F* will fall beyond the Object ; and then $FL : FD :: OD : OL$.

9. If the Object *AB* be so far distant from the Glass, that the Ray *BE*, refracted to the Eye *O*, diverges from the Point *F* in the Axis, between the Glass and the Object, then it will appear inverted, and the apparent Magnitude will be to the true Magnitude, in the Ratio compounded of *FL* to *FD*, and of *OD* to *OL*.

COPERNICAN SYSTEM of the World, is the antient *Pythagorean* System, which *Nicholas Copernicus*, a German, in a Treatise publish'd in *Latin* about the Year 1566, revived, after it had been for many Years thrown out of Doors ; and it supposes, that the Earth and the Planets revolve about the Sun, which stands still, as their Centre ; and that the Diurnal Motion of the Sun and Fixed Stars is not real, but imaginary, arising from the Motion of the Earth about its Axis.

CORBEILS, in Fortification, are are little Baskets about a Foot an half high, eight Inches broad at the Bottom, and twelve at the Top ; which, being filled up with Earth, are commonly set one against another upon the Parapet, or elsewhere, leaving certain Port-Holes, from whence to fire upon the Enemy under Covert.

CORBET, in Architecture, is a short Piece of Timber, placed in a Wall, with its End sticking out six or eight Inches ; and the under Part of this End sticking out is sometimes cut into the Figure of a *Boultin*, *Ogee*, and sometimes of a *Face*, &c. the upper Side being flat.

The Corbetts are usually placed, for Strength's Sake, just under the Semi-Girder of a Platform, and sometimes under the Ends of Camber-Beams.

COR CAROLI, an Extra-Constellated Star in the Northern Hemisphere, situated between *Coma Berenices*, and *Ursa Major*, so called in Honour of King *Charles II*.

COR HYDRA, a Fixed Star of the first Magnitude in the Constellation *Hydra*. Its Longitude

is 142 deg. 49 min. Latitude 22 deg. 23 min. and Right Ascension 133 deg. 20 min.

COR LEONIS. See *Regulus*, or *Basilicus*.

CORDON, in Fortification, is a Row of Stones, made round on the Outside, and set between the Wall and the Fortress, which lies aslope, and the Parapet, which stands perpendicular, after such a Manner, that this Difference may not be offensive to the Eye; whence those Cordons serve only as Ornaments, ranging round about the Place, being only used in Fortifications of Stone-Work: For in those made with Earth, the void Space is filled up with pointed Stakes.

CORDS, in Music, are the Sounds produced by an Instrument or Voice.

CORINTHIAN ORDER, of Architecture, being the fourth Order, is the richest and the most delicate of them all, and was invented by an Architect of Athens. Its Capital is adorned with Rows of Leaves, and of eight Voluta's, which support the *Abacus*. The Height of its Column is ten Diameters; and its Cornice is supported by Modillions.

CORNEA, is the hinder external Tunick of the Eye, being like a pellucid Horn, very firm, of a Spherical, or rather Spheroidal Figure, standing out behind the remaining Part of the Ball of the Eye, and consolidating the Eye, and *Sclerotica*.

CORNICHE, or *Cornice*, is the third and highest Part of the Entablature, and commonly signifies the uppermost Ornament of any Wainscot, &c. in Re-

gard to the Pillar; and is different, according to the different Orders of Architecture. In the *Tuscan* it is without Ornaments; and this Pillar, of all others, has the least Mouldings. The *Dorick* is adorned with *Dentils*, like the *Ionick*, and which sometimes has its Mouldings cut into it. The *Corinthian* Pillar, of all others, has the most Mouldings, and those very often cut with Modillions, and sometimes *Dentils*. The Composite has its *Dentils* and Mouldings cut, with its Channels or Chamferings under its Platfond.

CORNISH-RING of a Gun, is the next from the Muzzle-Ring backwards.

COROLLARY, or *Confectary*, is a Consequence drawn from something that has been already demonstrated; as, when it is demonstrated, *That two Semi-Circles can cut each other but in one Point*, therefore it follows from thence, *That two whole Circles can cut one another but in two Points*.

CORONA, in Architecture, is properly the flat and most advanced Part of the Cornice, call'd by us the *Drip*, because it defends the rest of the Work from Wind and Water. But by *Vitruvius* it is often taken for the whole Cornice.

CORONA BOREALIS, or the Northern Garland, a Constellation in the Northern Hemisphere, consisting of about twenty Stars.

CORONA MERIDIONALIS, a Southern Constellation, of thirteen Stars.

CORPUSCLES, in Natural Philosophy, signify the minute or small Parts of a Body. And

CORPUSCULAR PHILOSOPHY, is the Explanation of Things, and giving an Account of the Phænomena of Nature by the Motions and Affections of the minute Parts of Matter.

CORIDOR, in Fortification, is the Covert-Way lying round about the whole Compass of the Fortifications of a Place, between the Outside of the Moat and the Pallisadoes.

CORVUS, a Southern Constellation, consisting of seven Stars.

CO-SECANT, is the Secant of an Arch, which is the Complement of another, to 90 Degrees.

CO-SINE, is the Right Line of an Arch, which is the Complement of another, to 90 Degrees.

COSMOGRAPHY, is a Description of all the several Parts of the visible World, according to their Numbers, Positions, Motions, Magnitudes, and their other Properties.

CO-TANGENT, is the Tangent of an Arch, which is the Complement of another, to 90 Degrees.

CO-VERSED SINE, is the remaining Part of the Diameter of a Circle, after the Versed Sine is taken from it.

COVERT-WAY, in Fortification, is a Space of Ground level with the Field, on the Edge of the Ditch, about twenty Foot broad, ranging quite round the Half-Moons, and other Works, towards the County.

This is otherwise called *Corridor*, and has a Parapet raised on a Level, together with its Banquets and Glacis, which from the Height of the Parapet must follow the Parapet of the Place,

till it is insensibly lost in the Field. It has also a Foot-Bank.

One of the greatest Difficulties in a Siege, is to make a Lodgment on the Covert-Way, because the Besieged usually pallisadoe it along the Middle, and undermine it on all Sides. This is called the *Counterscarp*, because it is on the Edge of it.

COVING-CORNICE, is such a Cornice, that has a great Casemate, or Hollow in it, which is commonly lathed and plaister'd upon Compass Sprockets, or Brackets.

COUNT-WHEEL, is a Wheel in the striking Part of a Clock, moving round once in twelve or twenty four Hours. This by some is called the *Locking-Wheel*, because it has commonly eleven Notches in it at unequal Distances from one another, in order to make the Clock strike, and it is driven round by the Pinion of Report.

COUNTER-APPROACHES, are Works made by the Besieged, to hinder the Approach of the Enemy; and when they design to attack them in Form.

COUNTER-BATTERY, is one raised to play against another.

COUNTER-BREAST-WORK, the same with *False Bray*.

COUNTER-FORTS, are certain Pillars and Parts of the Walls of a Place, distant from fifteen to twenty Foot one from another, which are advanced as much as possible in the Ground, and joined to the Height of the Cordon by Vaults, to support the Way of the Rounds, and Part of the Rampart; as also to fortify the Wall, and strengthen the Ground; but are not now of much Use, unless in large Fortifications.

COUNTER-

COUNTER-FUGUE, in Musick, is when the Fugues proceed contrary to one another.

COUNTER-GUARDS, in Fortification, are large Heaps of Earth, in Figure of a Parapet, rais'd above the Moat, before the Faces, and the Point of the Bastion, to preserve them; and then they consist of two Faces, making an Angle-Salient, and are parallel to the Faces of the Bastion.

COUNTER-MINE, is a Subterraneous Passage, made by the Besieged, in Search of the Enemy's Mine, to give Air to it, to take away the Powder; or by any other Means to frustrate the Effect of it.

COUNTER-PART, a Term in Musick, only denoting one Part to be opposite to another: As, the Base is said to be the Counter-Part to the Treble.

COUNTER-POINT, is the old Manner of composing Pieces of Musick, before Notes of different Measures were invented; which was, to set Pricks or Points one against another, to denote the several Concords. The Length or Measure of which Points was sung according to the Quantity of Words or Syllables whereto they were applied.

COUNTERSCARP, is that Side of the Ditch that is next to the Country; or properly the Talus that supports the Earth of the Covert-Way; tho' by this Word is understood often the whole Covert-Way, with its Parapet and Glacis. And so it must be understood, when it is said, *The Enemy lodged themselves on the Counterscarp.*

COUNTER-SWALLOWS-TAIL, is an Outwork in Fortification,

in the Figure of a Single Tenaile, wider towards the Place, than it is, at the Gorge, than at the Head, or next to the Country.

COUNTER-TENOR, one of the mean or middle Parts of Musick, being called so, because it is opposite to the Tenor.

COURSE, in Navigation, is that Point of the Compass, or Coast of the Horizon, on which the Ship is to be steered from Place to Place; or it is more properly the Angle that is made by a Tangent to the Meridian, and an infinitely small Part of a *Rumb-Line* at the Point of Contact.

COURTINE, or *Courtain*, in Fortification, is the Front of the Wall between the Flanks of two Bastions; or the longest Straight Line that runs round the Rampart, drawn from one Flank to the other, being border'd with a Parapet five Foot high, behind which the Soldiers stand, to fire upon the Covert-Way, and into the Moat.

CRONICAL. See *Acronical*.

CROSS-MULTIPLICATION, is a Method, used by Workmen, of casting up superficial Dimensions of Feet, Inches, and Parts, by first setting down a Length taken in Feet and Inches, and setting the Feet and Inches of another Length, by which the former Length is to be multiply'd directly under the Feet and Inches of that Length; and then multiplying the Feet by the Feet, and (cross-wise) the Inches of one Length by the Inches of the other, and dividing the Sum of the Product by 12, and multiplying the Inches by the Inches, and dividing them by 144.

CROSS-STAFF, or *Fore-Staff*, is a Mathematical Instrument of Box,

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Box, or Pear-Tree, consisting of a Square-Staff, of about three Foot long, having each of the Faces thereof divided like a Line of Tangents, and four Cross-Pieces of unequal Lengths to fit on to the Staff, the Halves of which are as the Radius's to the Tangent Lines on the Faces of the Staff. This Instrument is used in taking the Altitudes of the Celestial Bodies at Sea.

CROSSIERS, are four Stars in Figure of a Cross, serving those that sail in the Southern Hemisphere, to find the South Pole.

CROTCHET, a Term in Musick, being the fifth Note of Time.

CROWN, in Geometry, is a plain Ring, included between two Concentrick Peripheries, and the Area thereof will be had by multiplying its Breadth by the Length of the Middle Periphery.

CROWNED HORN-WORK, is a Horn-Work with a Crown-Work before it.

CROWN-POST, is a Post which, in some Buildings, stands upright in the Middle, between two principal Rafters, and there goes *Struts* or *Braces* from it, to the Middle of each Rafter.

CROWN-WHEEL of a Watch, is the upper Wheel next to the Ballance, which by its Motion drives it, and in Royal Pendulums is called the *Swing-Wheel*.

CROWN-WORKS, in Fortification, are certain Bulworks advanced towards the Field to gain some Eminence, consisting of a large Gorge, and two Wings that fall on the Counterscarp near the Faces of the *Bastion*; so that they are defended by

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them, and next to the Field shew an entire Bastion, being between two *Demi-Bastions*, the Faces whereof look towards one another.

CRYSTALLINE Humour of the Eye. This Humour lies immediately next to the Aqueous within the Opening of the Tunica Uvea, and, like a Glass put over a Hole, collects and refracts the Rays of Light falling upon it, being very pellucid, in Figure of a Lens, unequally Convex.

Kepler, in *Paralip. in Vitellionem*, cap. 5. pag. 167. thinks, that the foremost Side of the Crystalline Humour is the Segment of a Spheriod, generated by their Volution of an Ellipsis about its Axis; and the hinder Side the Segment of an Hyperbolick Conoid, made from the Revolution of an Hyperbola about its Axis.

But *Shottus*, in *Libro de Univers. Nat. & Art. part 1. lib. 2. pag. 68.* says, That the Crystalline Humour is not of the same Figure in all Men, and even in the same Person, it varies according to his Age; for it is more round in some than others, and in a Person of full Age it is turgid, but in old Age it is almost flat.

CUBATURE of a Solid, is the Measuring the Space contained in it, or the finding the solid Content of it.

CUBE, is a solid Body, consisting of six equal Sides, being all Squares. The Solidity of any Cube is found by multiplying any one of its Sides, or Faces by the Height.

Cubes are to one another, in the Triplicate Ratio of their Dia-

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Diagonals, or of the Sides of their Faces.

CUBE-ROOT of any Number or Quantity, is such a Number or Quantity, which, if multiplied into itself, and then again the Product thence arising by that Number or Quantity, (being the Cube-Root,) this last Product shall be equal to the Number or Quantity whereof it is the Cube-Root; as 2 is the Cube-Root of 8, because two Times 2 is 4, and two Times 4 is 8; and $a+b$ is the Cube-Root of $a^3 + 3abb + 3baa + b^3$.

CUBICK EQUATION, in Algebra, is such an one wherein the unknown Quantities arises to three Dimensions; as $x^3 = a^3 - b^3$, or $x^3 + rxx = p^6$, or $x^3 + fxx - abx = mmn + pqr$, &c.

All Cubick Equations have three Roots, either real or imaginary.

All Cubick Equations may be reduced to this Form, $x^3 + qx + r = 0$; wherein the second Term is wanting; and they may be extracted if q be affirmative, or even negative, provided that $\frac{q^3}{27}$ be not greater than $\frac{r}{4}$.

CUBICK FOOT of any Substance, is so much of it as is contained in a Cube whose Side is one Foot.

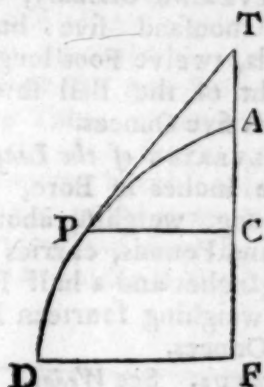
CUBICK NUMBER, is that Number which is produced by multiplying any Number by itself, and then again the Product by that Number; as, 27 is a Cubick Number, since 3 multiplying 3, produces 9; and again, 3 multiplying 9, produces 27.

The Difference of two Cube-Numbers, whose Roots differ by Unity, is equal to the Ag-

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gregate of the Square of the Root of the greater, double the Square of the less, and the less Root.

CUBICK PARABOLA, is such a one wherein the Cubes of the Ordinates PC, DF , are as the Squares of the Abscissa's AC, AE .



Any Part PA of the Curve of the Cubick Parabola is rectifiable: For if the Parameter be

$\frac{9}{4} aa$, and the Tangent PT be called t , and the Ordinate PC, y^4 , then will the Curve AP be $= \frac{2}{3} t + \frac{8at}{27y} - \frac{8}{27} a$.

The Area of a Cubick Parabola is three Fourths of its Circumscribing Parallelogram.

CUBO-CUBE, the sixth Power.

CUBO-CUBO-CUBE, the ninth Power.

CULMINATION of a Star, in Astronomy, is the Passage thereof over the Meridian: And so a Star is said to culminate when it passes over the Meridian.

CULVERING, a Species of Ordnance; of which there are three Sorts, viz. the Extraordinary, the Ordinary, and the Least-sized Culvering.

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CULVERING Extraordinary, is five Inches and a half in Bore, thirteen Foot long, weighs four thousand eight hundred Pounds. Its Load is about twelve Pounds, and it carries a Shot of five and a half in Diameter, weighing twenty Pounds.

CULVERING Ordinary, weighs four thousand five hundred Pounds, twelve Foot long, the Weight of the Ball seventeen Pounds five Ounces.

CULVERING of the Least Size, is five Inches in Bore, eleven Foot long, weighing about four thousand Pounds, carries a Shot three Inches and a half Diameter, weighing fourteen Pounds nine Ounces.

CUNEUS. See *Wedge*.

CURRENTS, are certain Progressive Motions of the Waters of the Sea in several Places, either quite down to the Bottom, or to a certain determinate Depth; and these carry the Ships faster, or else retard their Motion, according as the Current sets with or against the Ships Motion.

CURSOR, in Mathematical Instruments, is any small Piece that slides; as, the Piece in an Equinoctial Ring-Dial that slides to the Day of the Month. Likewise the little Ruler or Label of Brass, being divided like a Line of Sines, and sliding in a Groove along the Middle of another Label, representing the Horizon in the Analemma, is called a *Cursor*.

CURTATED DISTANCE, is the Distance of the Place of a Planet from the Sun reduced to the Ecliptick.

CURTATION, is the Difference between the Distance of a Pla-

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net from the Sun and the Curtated Distance.

CURVATURE. This signifies Crookedness.

CURVE, the same as Crooked.

CURVES, in Geometry, are such Lines, wherein different Points are placed towards different Parts.

CUT-BASTION. See *Bastion*.

CUVETTE, in Fortification, is a deep Trench about four Fathom broad, which is commonly sunk in the Middle of the great dry Ditch till you come to Water, and serves both to prevent the Besiegers Mining, and also the better to keep off the Enemy.

CYCLE, is a perpetual Revolution of certain Numbers, which successively go on from the first to the last, and then return again to the first, and so circulate perpetually. There are three principal Cycles, viz. the *Cycle of Indiction*, the *Cycle of the Moon*, and the *Cycle of the Sun*.

CYCLE of Indiction, is a Revolution of fifteen Years, which first began the third Year before Christ.

Chronologers disagree about the Time that the Cycle of Indiction begun; and also concerning the Use that the Romans invented it for: But, according to vulgar Computation, the Year of Christ's Nativity was the third of this Cycle; and thus we are certain, that it was established by *Constantine* in the Year 312.

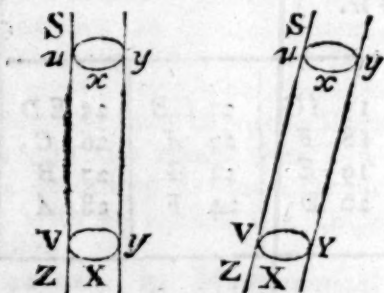
If you subtract 312 from the Year given, and divide the Remainder by 15, and what remains, omitting the Quotient, is the Year of the *Roman Indiction*;

der the Curve of the Cycloid and the Base, is the Tripple of the generating Circle.

4. The Length of any Arch AP , of a Cycloid, is equal to four Times the Vers'd Sine of half the Arch AH , of the generating Circle between the Describing Point a and the Base of the Cycloid; whence the Length of the whole Cycloid is equal to four Times the Diameter of the generating Circle.

CYGNUS, the *Swan*, a Constellation in the Northern Hemisphere.

CYLINDER. If any indefinite Right Line SZ , being without the Plane of the Circle VXY , moves about the Circumference of that Circle always parallel



to itself, until it be returned to the same Place from whence it went, then the indefinite Solid contain'd under the Base or Circle VXY , and the Superficies generated after this Manner by the Right Line SZ , is called a *Cylinder*, and the said Superficies is called the Superficies of it; and if the Line SZ be perpendicular to the Plane of the Base, the Cylinder is called a Right one; but if not, an Oblique or Scalene one.

1. The Section of every Cylinder by a Plane Oblique to its Base, is an Ellipsis.

2. The Superficies of a Cylinder is equal to the Periphery of the Base, multiplied into the Length of its Side.

3. The Solidity of a Cylinder is equal to the Area of its Base, multiplied into its Altitude.

4. Cylinders of the same Base, and standing between the same Parallels, are equal.

5. Every Cylinder is to a Spheriod inscrib'd in it, as 3 to 2.

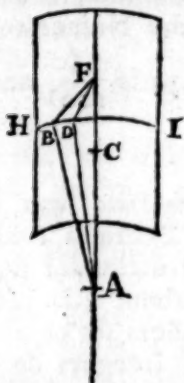
6. If the Altitudes of two Right Cylinders be equal to the Diameters of their Bases, those Cylinders are to one another as the Cubes of the Diameters of their Bases.

CYLINDRICAL SPECULUM, is a Cylinder of Polish'd Metal; being either Convex or Concave.

The Images of formous Objects, seen by the Reflection of the Surface of the Convex Cylindrick Speculum, are render'd deformed; and *vice versa* the Images of deformed Objects appear formous; so that a Figure altogether confused, seeming to be drawn without any Manner of Intent, being placed horizontally near one of these Cylinders, will appear in the Surface of the Cylinder the Face of a Man, or any other formous Figure. But then the confused Figure must be first drawn according to Art.

If Parallel Rays fall after such a Manner in the Superficies of a Concave Cylinder, as to cut its Axis at Right Angles, and their Inclination to the Speculum be less than sixty Degrees, after the Reflection, they will be united in a Right Line,

Line, parallel to the Axis, being at a Distance less than one fourth Part of the Diameter.



The Rays *AB*, *AD*, which, from the same Point *A* of the Axis, fall in the same Periphery *HI* of a Concave Cylinder, after the Reflection, are united in the Point *F*, so far distant from *C*, the Centre of the Circle, in the Periphery whereof the Reflection is made, as the Radiating Point *A* is distant from it.

CYMATIUM, a Member of Architecture; whereof there are two Sorts, viz. the *Dorick* and the *Lesbick*. The *Dorick* is a Member that has a Concavity less than a Semi-circular one, and a Projecture equal to half the Altitude. The *Lesbick* is both Concave and Convex, having the Projecture equal to half the Altitude.

CYNOSURA, a Constellation consisting of seven Stars, being otherwise called *Ursa Minor*.

CYPHER, or Nought, noted thus, (0); which being put before a Figure, signifies nothing, (unless in Decimals, where it augments, being put before, in the same Proportion, as when put after Integers.) But after a Figure, it increases it by Tens; and so on, *ad infinitum*.

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DACTYLONOMY, the Art of Numbering on the Fingers.

DADO, a Term in Architecture, used by some Writers for a Dye, being the Part in the Middle of the Pedestal of a Column, between its Base and the Cornice.

DAILY MOTION of a Planet. See *Diurnal Motion*.

DARKENED ROOM. This is the same as *Camera Obscura*; being a Room darkened all but in one little Hole, having a Convex-Glass in it to transmit the Rays of outward Objects to a Piece of Paper, or white Cloth in the Room.

DARK TENT, by some Writers, is the Name of a small Portable *Camera Obscura*.

DATA, is the Term, in Mathematicks, for such Things or Quantities as are given or known, in order to find out other Things thereby, which are unknown.

DAVIS'S QUADRANT, the common *Sea-Quadrant*, or *Back-Staff*.

DAY, is either *Natural* or *Artificial*.

DAY (NATURAL), is the Space of Time determin'd by the Motion of the Sun round the Earth in twenty four Hours, and begins at 12 at Night.

DAY (ARTIFICIAL), is the Time between the Sun's Rising and Setting. The Length of this varies in different Places of the Earth; for under the Equinoctial the Artificial Days are but

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twelve Hours long, and under the Poles they are half a Year.

The Natural Day is also called *Civil*, because it is by divers Nations reckon'd divers Ways. The *Babylonians* began to account their Day from the Sun-Rising: The *Jews* and *Athenians* from the Sun-Setting, whom the *Italians* now follow, beginning their first Hour at Sun-set. The *Egyptians* began at Midnight, as we account the Astronomical Day; but the *Umbri* began at Noon.

DECAGON, in Geometry, is a Plane Figure of ten Sides, and ten Angles; and if all the Sides are equal, and all the Angles, it is called a *Regular Decagon*; and it may be inscrib'd in a Circle.



If *AB* be the Side of a Regular Decagon inscrib'd in a Circle, and it be continu'd out to *C*, so that $BC = AD$, then will $AB : BC :: BC : AC$.

If the Side of a Regular Decagon be 1, the Area thereof will be 8.69; whence as 1 to 8.69, so is the Square of the Side of any given Decagon to the Area of that Decagon.

DECIMAL FRACTIONS, are such that have 10, 100, 1000, 10000, &c. for their Denominator; as, $\frac{5}{10}, \frac{6}{100}, \frac{57}{1000}, \frac{834}{10000}$

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&c. and the Denominator for Brevity and Conveniency Sake, is commonly express'd by a Point, or Comma, set on the Left Hand of the Numerator, thus,

.5 is $\frac{5}{10}$, .34 is $\frac{34}{100}$, and .346 is $\frac{346}{1000}$.

Regiomontanus was the first that used Decimal Fractions in the Construction of the Tables of Sines, about A.D. 1464.

As Cyphers set on the Right Hand of Integers do increase the Value of them decimally, as 2, 20, 30, &c. so when set on the Left Hand of Decimal Fractions, they decrease the Value decimally, as .5 .05 .005 &c. But set on the Left Hand of Integers, or on the Right Hand of Decimal Fractions, they signify nothing, but only to fill up void Places. Thus, .5000 or 0005. is but five Unites.

Arithmetical Operations may be perform'd vastly sooner by Decimal Fractions than by Vulgar Fractions, because the Denominators being omitted, the Rules of Addition, Subtraction, Multiplication, and Division, are performed as in whole Numbers, Regard being had to the Pointing, which is easy: Yet, by these, Operations will not always come out exactly true; but you may come as near the Truth as possible, by bringing out more Figures.

DECIMAL SCALES, are, in general, any Scales upon a square Rule, that are divided decimally, being Scales of Money, Weights, Measures, made from Tables bearing those Names, and serve readily, by Inspection, only to shew you the Decimal

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Decimal Fraction that properly belongs to any Part of Money, Weight, or Measure, &c.

DECLINATION (APPARENT,) is the Distance of the Apparent Place of a Planet from the Equinoctial.

DECLINATION of the Sun, or any Star, or Point of the Heavens, is its Distance from the Equator, measur'd in the Arch of a great Circle, perpendicular to the Equator. *R : S ☉'s Place :: S. greatest Declination S. of his present Declination.*

The greatest Declination of the Sun, or of the Ecliptick, was first, as we know of, observed by *Pytheas*, at *Mastilia*, about three hundred and twenty four Years before Christ; who observing that the Height of a Gnomon was to the Shadow of it, when the Sun was in the Meridian, as, $31951\frac{1}{2}$ to 90000, from thence concluded the Sun's greatest Declination to be 23 deg. 52 min. 41 sec. And *Gassendus* found the Solstitial Shadow of the same Length, as it had been observed by *Pytheas*, near two thousand Years before: And so he concluded that the Sun's greatest Declination, or that of the Ecliptick, is constant. But from a Comparison of the several Observations concerning this Matter, the Sun's greatest Declination is commonly accounted 23 deg. 30 min.

DECLINATION of the Sea-Compass, or of the Needle, is its Variation from the true Meridian of any Place.

DECLINATION (TRUE,) is the Distance of the True Place of a Planet from the Equator.

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DECLINATION of a Wall, or Plane for Dials, is an Arch of the Horizon, contained either between the Plane and the Prime Vertical Circle, if you reckon it from the East or West; or else between the Meridian and the Plane, if you account it from the North or South.

DECLINATORIES, are Instruments contriv'd for taking the Declinations, Inclinations, and Reclinations of Planes; and are of several Kinds. The best whereof, for taking the Declination, consists of a square Piece of Brass, or Wood, with a Limb accurately divided into Degrees, and every fifth Minute, if possible, having a Horizontal Dial moving on the Centre, made for the Latitude of the Place it is to serve in, and which has a small Bit of fine Brass fixed on its Meridian Line, like a Fiducial Edge, to cut the Degrees of the Limb: For at any Time when the Sun shines, by having the Hour of the Day, you may get the Declination of any Wall or Plane by this Instrument.

DECLINING ERECT-DIALS, are those whose Planes do stand perpendicular to the Horizon, and decline, that is, do not face directly the four Cardinal Points.

DECLINING ERECT-PLANES. See *Erect Declining Planes*.

I. Because the Distance of the Sun from the Centre of the Earth is so vastly remote, that all Points of the Superficies of the Earth may be taken as if they were in the Centre, the Styles of all Dials may be conceived as Parts of the Axis of the

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the Earth passing thro' the Centre of the Earth.

2. The Extremity of the Style of all Dials may be taken for the Centre of the Earth.

3. The Hour-Lines drawn upon all Dial-Planes, are the common Sections of Hour-Circles of the Sphere with the Dial-Planes.

The Equinoctial Circle upon all Dial-Planes will be a Straight Line, and the Parallels of Declination will be the Conick Sections.

DECUSSATION, a Term in Opticks, signifying the Crossing of any two Lines, Rays, &c. when they meet in a Point, and then go on separate from one another.

DEFENCES, in Fortification, are all Sorts of Works that cover and defend the opposite Posts, as Flanks, Parapets, Casemates, &c. No Miner can be fixed to the Face of a Bastion before the opposite one be ruin'd, or till the Parapet of its Flank be beaten down, and the Cannon in all Parts that can fire upon that Place which is attack'd, are dismounted.

DEFERENT, in the old *Ptolemaick* System, is an imaginary Circle, which, as it were, carries about the Body of a Planet, and is the same with the *Excentrick*.

DEFICIENT HYPERBOLA, is a Curve having but one Asymptote, and only two Hyperbolic Legs running out infinitely next to the Asymptote contrary ways.

DEFICIENT NUMBERS, are such, whose Parts, added together, make less than the Integer whereof they are the Parts; as 8, whose Parts being 1, 2,

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4, make but 7; likewise 16, whose Parts 1, 2, 4, 8, make but 15.

DEFILE, in Fortification, is a straight narrow Lane, or Passage, thro' which a Company of Horse or Foot can pass only in File, by making a small Front, so that the Enemy may take an Opportunity to stop their March, and to charge them with so much the more Advantage, in regard that those in the Front and Rear cannot reciprocally come to the Relief of one another.

DEFINITIONS, are our first Conceptions of Things, by Means whereof they are distinguish'd among themselves, and from whence, whatsoever Things being conceived by them, the rest are deduced. There are two Kinds of Definitions, *viz.* Nominal and Real.

DEFINITION (NOMINAL), is an Enumeration of such known Things that are sufficient for the distinguishing of any proposed Thing from others; as is that of a Square, if it be said to be a Quadrilateral, Equilateral, and Rectangular Figure.

DEFINITION (REAL), is a distinct Notion of the Genesis of a Thing, that is, which expresses the Manner how the Thing can be done, or made; as is this Definition of a Circle, *viz.* That it is describ'd by the Motion of of a Right Line about a fixed Point.

DEFLECTION, is the Tendency of a Ship from her true Course, by reason of Currents, &c. which turn her out of her right Way. But this Word, by *Dr. Hook*, is applied to the Rays of Light, that is, Deflection of the

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the Rays of Light is different both from Reflection and Refraction, and is made towards the Surface of the Opacous Body perpendicularly; and this is the same Property that Sir Isaac Newton calls *Inflexion*.

DEGREE, is the three hundred and sixtieth Part of the Circumference of a Circle. It is subdivided into sixty Parts, called *Minutes*, and each of them again into sixty more, called *Seconds*, &c.

DELPHINUS, the *Dolphin*, a Constellation in the Northern Hemisphere, containing ten Stars.

DEMI-BASTION, is a Fortification, having only one Face, and one Flank.

DEMI-CANNON *Lowest*, the Name of a great Gun. (The ordinary ones are about six Inches Bore, five thousand four hundred Pound Weight; some ten; some eleven Foot long; and carry a Shot of about thirty Pound Weight.) It carries point-blank a hundred and fifty six Paces. Its Charge of Powder is fourteen Pound Weight. There are also two Sizes of Demi-Cannon above this, which are something larger: As the

DEMI-CANNON *Ordinary*, which is six Inches and a half Bore, twelve Foot long, weighs five thousand six hundred Pound. Its Charge of Powder is seventeen Pounds, eight Ounces, carries a Shot of six Inches one Eighth in Diameter, whose Weight is thirty two Pounds, and the Piece shoots point-blank a hundred and sixty two Paces.

DEMI-CANNON, *of the longest Size*, is six Inches three Fourths

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Bore, twelve Foot long, six hundred Pounds Weight. Its Charge is eighteen Pounds of Powder, and the Piece shoots point-blank a hundred and eighty Paces.

DEMI-CROSS, is an Instrument used by the *Dutch* to take the Altitudes of the Celestial Bodies at Sea, and consists of a Staff divided into a Line of Tangents, and a Cross-Piece, or Transom, and has three Vanes. But we do not use this Instrument, the Sea-Quadrant being better.

DEMI-CULVERING, a Piece of Ordnance. The common Sort of them are four Inches and a quarter Bore, two thousand seven hundred Pounds Weight, ten Foot long, carries a Shot of ten Pounds eleven Ounces, is charged with seven Pounds four Ounces of Powder, and shoots point-blank a hundred and seventy five Paces.

DEMI-CULVERING *of the least Size*, is four Inches and a quarter Bore, ten Foot long, two thousand Pounds Weight. Its Charge is six Pounds four Ounces of Powder, it carries a Ball of four Inches Diameter, and of nine Pounds Weight, and its Level-Range is a hundred and seventy four Paces.

DEMI-CULVERING *of the largest Sort*, is four Inches and three quarters Bore, ten Foot and one Third long, three thousand Pounds Weight. Its Charge of Powder is eight Pounds and eight Ounces, the Ball is four Inches and a Half Diameter, weighs twelve Pounds eleven Ounces, and it shoots point-blank a hundred and seventy eight Paces.

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DEMIDITON, a Note in Musick, being the same with *Tierce Minor*. See *Monochord*.

DEMI-GORGE, in Fortification, is half the Gorge or Entrance into the Bastion, not taken directly from Angle to Angle, where the Bastion joins to the Courtain, but from the Angle of the Flank to the Centre of the Bastion, or Angle, the two Courtains would make, were they protracted to meet in the Bastion.

DEMI-QUAVER, the last Note of Time in Musick.

DEMONSTRATION, is the Reasons that are laid down for making the Mind assent to the Truth or Falshood of a Thing proposed.

DENEB, the same with *Canda Lucida*, or *Lion's Tail*, a Star so called. Which see.

DENOMINATOR of a Fraction, is the Number or Letter below the Line. Thus 4 and *b* are the Denominators of the Fractions,

$$\frac{3}{4} \text{ and } \frac{a}{b}.$$

DENOMINATOR of any Proportion, is the Quotient arising from the Division of the Antecedent by the Consequent; as, 6 is the Denominator of the Ratio of 30 to 5, since $5 \div 30 = 6$; and this is also called the *Exponent of the Ratio*.

DENSITIES of Bodies, is their Thickness; and a Body is said to be denser, when it contains more Matter under the same Bulk than another Body.

The Densities of any two Bodies are in a Ratio compounded of the direct Ratio of their Quantities of Matter, and the Reciprocal Ratio of their Bulks.

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DENTICLES, are Ornaments in a Cornice, cut after the Manner of Teeth. These are particularly affected in the Dorick Order; and the square Member whereon they are cut, is called the *Denticule*.

DEPARTURE, in Navigation, is the Easting or Westing of a Ship, with regard to the Meridian it departed or sailed from; or it is the Difference of Longitude between the present Meridian the Ship is under, and that where the last Reckoning or Observation was made; and, in all Places, except under the Equator, it must be accounted according to the Number of Miles in a Degree of the Parallel the Ship is in.

The *Departue*, in *Plain* and *Mercator's* Sailing, is always represented by the Base of a Right-Angle Triangle, where the Course is the Angle opposite to it, and the Distance the Hypothenuse. In the *Plain* and *Mercator's Chart*, as Radius to the Distance, so is the Sine of the Course to the Departure.

But this is erroneous, except in very small Distances; for if the Distance and Difference of Latitude be represented by the Hypothenuse and Perpendicular of a Right-angled Plain-Triangle, the Departure will not be the Base of that Triangle; as Mr. *Hodg-n* says it will, in his *System of Mathematicks*. See more of this under the Word *Rhumb*, where it will easily appear to be false.

DEPRESSION of the Pole. So many Degrees as you sail or travel from the Poles towards the Zenith, you are said to depress

D E

press the Pole, because it comes the same Number of Degrees lower, or nearer to the Horizon.

DESCANT, in Musick, signifies the Art of Composing in several Parts, and is threefold, viz. *Plain*, *Figurate*, and *Double*.

DESCANT (DOUBLE,) is when the Parts are so contriv'd, that the Treble may be made the Bass; and, on the contrary, the Bass the Treble.

DESCANT (FIGURATE or FLORID,) is that wherein Discords are concerned as well (tho' not so much) as Concords, and having all the Variety of Points, Figures, Syncopes, Diversities of Measures, and whatsoever else is capable of adorning the Composition.

DESCANT (PLAIN,) is the Ground-work or Foundation of the Musical Composition, and wholly consists in the ordinary Placing of many Chords.

DESCENSION OBLIQUE. See *Oblique Descension*.

DESCENSION RIGHT. See *Right Descension*.

DESCENTS, in Fortification, are the Holes, Vaults, and hollow Places, made by undermining the Ground; as the *Counter-scarp* or *Covert-Way*; so that a Descent into the Moat or Ditch, is a deep Digging into the Earth of the Covert-Way, in Figure of a Trench, of which the upper Part is cover'd with Madriers or Clays, against Fires, to secure the Passage into the Moat.

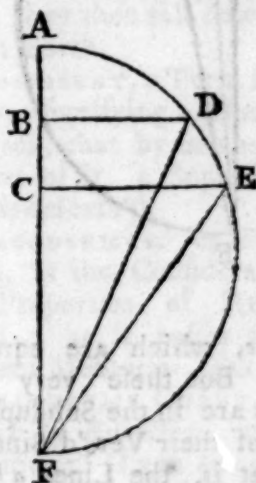
DESCENT of heavy Bodies. 1. If two Bodies descend perpendicularly from any unequal Heights near the Surface of the Earth, the Lengths of the Lines that

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they describe, are in the Duplicate Ratio of the Times or Velocities; and so the Velocities are as the Times.

But if Bodies descend perpendicularly from any Heights whatsoever, then this Proportion will not hold.

If AEF be a Semicircle, and F the Centre of the Earth, and



a Body falls from any Height A above the Surface of the Earth to Places B , C , and the Lines BD , CE , are drawn; as also the Lines FD , FE , then the Times of its falling the Lengths AB , AC , will be express'd by the Trilineal Spaces FAD , FAE .

The Lengths that a Body near the Surface of the Earth descends in equal Times, do increase according to the odd Numbers, 1, 3, 5, 7, 9, &c.

Hence, by way of Corollary, if the Body falls from the Point a , the small Distances ab , ac , compar'd with aF the Semidiameter of the Earth, the Trilineal Figures Fad , Fae , may be taken for Right-angled Triangles, whose Areas will be, to one another, as the Lines bd , ce ,

DE

ce, since the Base aF is common, that is, as the very small Arches



ad , ac , which are equal to them. But these very small Arches are in the Subduplicate Ratio of their Vers'd Sines ab , ac , that is, the Lines ab , ac , describ'd by a descending Body, are in the Duplicate Ratio of the Times, which is the Theorem first laid down.

2. All Bodies near the Surface of the Earth do descend perpendicularly at such a Rate, as that at the End of the first Second of Time they have describ'd sixteen Feet one Inch.

3. The Velocity of a heavy Body descending in an Inclined Plane at the End of any given Time, is to the Velocity that it would acquire by descending perpendicularly in the same Time, as the Altitude of the Inclined Plane is to its Length.

4. The last Velocity acquired by the Direct Descent, is to the last Velocity acquired in the same Time by the Oblique Descent, as the Absolute Gravi-

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ty is to the Relative Gravity of the Descending Body.

5. The Line describ'd by the Direct Descent is to the Line describ'd in the same Time by the Oblique Descent, as the Length of the Plane to the perpendicular Height of the Plane.

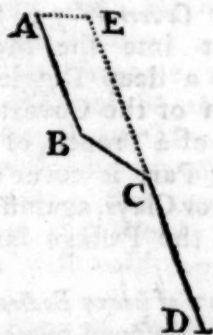
6. If the Line describ'd by the Direct Descent be to the Line describ'd by the Oblique Descent, as the Height of the Plane to the Length of the Plane, then the Times of Descent shall also be in that Proportion.

7. If the Line describ'd by the Direct Descent be to the Line describ'd by the Oblique Descent, as the Height of the Plane to the Length of the Plane, the last Velocities shall be equal.

8. The last Velocities acquir'd upon several Inclined Planes of the same Heights, and however differing in Length, are equal.

9. The Time of an Oblique Descent through any Chord of a Circle, drawn from the lowest Point of the Circle, is equal to the Time of a Direct Descent through the Diameter of that Circle.

10. If a Body descends from the Point A through any Number



of Inclined Planes, AB , BC , CD , it will acquire the same Velocity

D E

city at the Point *D*, in the End of its Fall, as though it fell from the Point *E* of equal Height with *A*, in one continu'd Plane *ED*.

11. The last acquir'd Velocities of a Body, descending to the lowest Points of a given Circle, through different Chords, shall be as those Chords.

In all these Theorems concerning the Descent of Bodies on Inclined Planes, the Lengths of the Planes must be inconsiderable, with regard to the Semidiameter of the Earth; for otherwise they are not true.

12. The Time of the Descent of a Body, through the Arch *BC* of



a Semi-Cycloid, is equal to the Time of its Descent through any other Arch *AC*.

13. Also a Body will descend from a given Point, as *B* to a given Point *C*, sooner along the Arch *BC* of a Cycloid than along any other Curve, drawn through the Points *B*, *C*.

14. If Water runs out thro' a small Hole, made in the Bottom of a Parabolick Conoid, the Surface of the Water will descend equal Spaces in equal Times.

15. If a Body be thrown downwards in a resisting Medium, with such a Velocity as shall make the Resistance of the Medium equal to the Acceleration of Gravity, it will move on, or descend with a uniform Motion.

16. The Velocity of a Body de-

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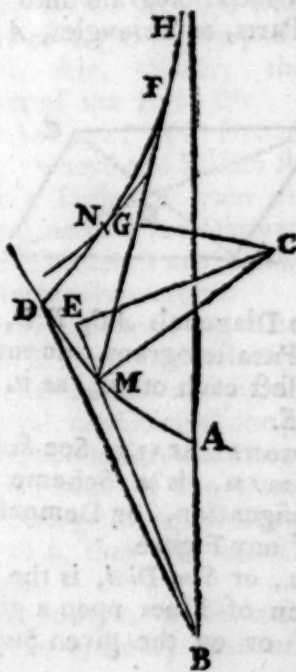
scending by its own Weight, in a resisting Medium, is always less than that Velocity that produces the uniform Motion; but continually approaches to it.

Dew, are little Globuls of Water, rais'd up from the Earth by Heat, which, for a while, swim up and down in the Air; and when several of them convene into Drops, by Means of Cold, they then fall down again to the Earth.

DESCRIBENT, a Term in Geometry, signifying a Line or Superficies, that by means of the Motion of it, a Superficies or Solid is describ'd.

DIACOUSTICKS, or *DIAPHONICKS*, is the Consideration of the Properties of Refracted Sound, as it passes through different Mediums. But the

DIACOUSTICK CURVE, or the *Causick by Refraction*, is generated thus: If you imagine an infinite Number of Rays, *BA*,



B M,

B M, B D, &c. issuing from the same Luminous Point *B*, to be refracted to or from the Perpendicular *M C*, by the given Curve *A M D*; and so, that *C E*, the Sines of the Angles of Incidence *C M E* be always to *C G*, the Sines of the Refracted Angles *O M G* in a given Ratio, the Curve *H F N*, which touches all the Refracted Rays, *A H, M F, D N, &c.* is called the *Diaconstick*, or *Caustick* by *Refraction*.

DIADROME. This is the same with *Vibration*, or the Swing of a Pendulum.

DIAGONAL, is a Straight Line drawn a-croſs a Figure, from one Angle to another, and is called a *Diameter* by some. These are chiefly in Quadrilateral Figures.

As the Lines *A C, B D*, are the Diagonals of the Parallelogram *A B C D*.

Every Diagonal, as *A C*, divides a Parallelogram into two equal Parts, or Triangles, *A B C, A D C*.



Two Diagonals *A C, B D*, of every Parallelogram, do mutually biseſt each other, as in the Point *E*.

DIAGONAL SCALE. See *Scales*.

DIAGRAM, is a Scheme for the Designation, or Demonstration of any Figure.

DIAL, or *Sun-Dial*, is the Description of Lines upon a given Plane, or on the given Super-

ficies of any Body, after such a Manner, that the Shadow of a Gnomon, or the Rays of the Sun, transmitted through some Hole, or reflected from a very little reflecting Substance, shall touch given Lines at a given Hour. And the Manner of this Description is called *Dialing*.

The first Sun-Dial, that was set up at *Rome*, was by *Papyrius Cursus*, about the 447th Year of the City, in the Temple of *Quirinus*; but it went not right. And about thirty Years afterwards, *M. Valerius Messala* brought another out of *Sicily*, and set it up upon a Pillar near the *Rostrium*. But this went not right neither, because not made for the Latitude of *Rome*. But about eleven Years after there was one set up, that went more exact.

The Invention of Sun-Dials are by some attributed to *Anaximenes*; and by some to *Thales*. And *Vitruvius*, among the various Kinds of Dials he mentions, says, That *Berosus* the *Chaldean* invented one upon a Reclining Plane, nearly parallel to the Equinoſtial.

DIAL (CYLINDRICAL,) is a Dial drawn upon the Convex Superficies of a Cylinder, where the Hour Lines are Curves, drawn by Means of the Sun's several Altitudes every Day that he enters into the Beginnings of the Signs; and the Hour of the Day is shewn by the Extremity of the Shadow of a Style, standing at Right Angles to the Surface of the Cylinder on the Top thereof.

DIALING GLOBE, is an Instrument of Brass, or Wood, with a Plane fitted to the Horizon,

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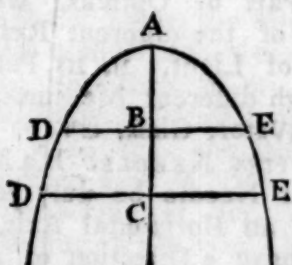
zon, and an Index particularly contrived, to give a clear Demonstration of that Art.

DIALLING LINES, or *Scales*, are such divided Lines, as being put on Rulers, or the Edges of Quadrants, and other such like Instruments, serve to shorten the Business of Dialling.

DIALLING SPHERE, is an Instrument made of Brass, with several Semi-Circles sliding over one another, upon a moveable Horizon, to demonstrate the Nature of Spherical Triangles, and to give the true Idea of drawing Dials on all Sorts of Planes.

DIAMETER of a Circle, is a Right Line that passes through the Centre of the Circle, and is both ways terminated by the Circumference, and does divide the Circle into two equal Parts.

DIAMETER of a Curve, is a Right Line, as *AC*, that bisects the Right Lines, *DE*, *DE*,



drawn parallel to one another; and are either of a finite or infinite Length.

DIAMETER CONJUGATE in the Ellipsis. See *Conjugate Diameter*.

DIAMETER of Gravity, in any Surface or Solid, is that Right Line in which the Centre of Gravity is placed.

DIAMETER PRINCIPAL. See *Principal Diameter*.

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DIAMETER TRANSVERSE. See *Transverse Diameter*.

DIAMETRICALLY OPPOSITE, is when two Things are the most opposite to one another that they can be; as one End of the Diameter of a Circle is to the other.

DIAPASON, a Term in Musick, being a Chord including all Tones; and is the same with what we call an *Eighth*, or an *Octave*, because there are but seven Tones, or Notes, and then the Eighth is the same again as the First.

If the Tension of two equal Strings be to each other, as 1 to 2, their Tones will produce an Octave.

DIAPENTE, or *Perfect Fifth*, is the Second of the Concorde, making an Octave with the *Diatessaron*.

If the Tension of two equal Strings be as 3 to 2, then they will sound a *Diapente*.

DIAPHANOUS BODY, or *Medium*, is that through which the Rays of Light freely pass; as is Glass, Air, Water, the Humours of the Eye, &c.

DIASTYLE, is a sort of Edifice, where the Pillars stand at such a Distance from one another, that three Diameters of their Thickness are allow'd for the Intercolumnation.

DIATESSARON, a Term in Musick, being otherwise called a *Perfect Fourth*, and signifies an Interval, consisting of one greater Tone, one lesser, and one greater Semi-Tone. If the Tension of two Strings of equal Bigness be as 3 to 4, they will sound a *Diatessaron*.

DIATONICK, a Term signifying the ordinary Sort of Musick,

D I

lick, which proceeds by different Tones, either in ascending or descending. It contains only the two greater and lesser Tones, and the greater Semi-Tone.

DIESES, in Musick, is the Division of a Tone below a Semi-Tone, or an Interval composed of a lesser and imperfect *Semi-Tone*. So that when Semi-Tones are placed where there ought to be Tones, or when a Tone is set where there should be only a Semi-Tone, this is called *Diesis*.

DIESES (ENHARMONICAL,) is the Difference between the greater and lesser Semi-Tones.

DIFFERENCE, is the Excess whereby one Magnitude exceeds another.

DIFFERENCE of *Ascension*. See *Ascensional Difference*.

DIFFERENCE of *Longitude* of two Places of the Earth, is an Arch of the Equator contained between the Meridians of those two Places.

DIFFERENTIAL of any Quantity, is the same as the Fluxion of that Quantity. This Word is not used by us.

DIFFUSION, commonly signifies the dispersing of the subtle Effluvia of Bodies into a kind of Atmosphere all round them.

DIGIT, in Astronomy, is the twelfth Part of the Diameter of the Sun or Moon, and is used to express the Quantity of an Eclipse.

DIGITS, or *Monades*, a Term in Arithmetick, which signifies any Integer under 10; as 1, 2, 3, 4, 5, 6, 7, 8, 9.

DILATATION, signifies a Thing taking up more Space than it did before.

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DIMENSION, in Geometry, is either Length, Breadth, or Thickens; as, a Line hath one Dimension, viz. Length; a Superficies two, viz. Length and Breadth; and a Body or Solid has three, viz. Length, Breadth, and Thickness. This Word is also used with regard to the Powers of the Roots of an Equation, which are called the *Dimensions of that Root*: As in a Cubick Equation the highest Power has three *Dimensions*.

DIMETIENT. The same with *Diameter*.

DIMINISHED ANGLE, a Term in Fortification. See *Angle*.

DIMINUTION, in Musick, is nothing else but the abating something of the full Value or Quantity of any Note.

DIOPTR, the same with the Index or Alhidada of an Astrolabe, or such-like Instrument.

DIOPTRICKS, is the Science of Refracted Vision; or it is that Part of Opticks, which treats of the different Refractions of Light, in its Passage through different Mediums, as Air, Water, Glass, &c.

DIPPING NEEDLE. If a Magnetical Needle be duly poised about an Horizontal Axis, it will have a Direction of Altitude above the Horizon, besides its Direction towards the North, in an Horizontal Position, always pointing to a determinate Degree of Altitude or Elivation, above the Horizon, in this or that Place respectively. It is now called a *Dipping Needle*. And Mr. *Whiston* of late has endeavour'd to discover the Longitude by it.

DIPTERON, in Architecture, a Name which the Antients attributed

tributed to those Temples, which were encompassed with a double Row of Pillars, making two Portico's, which they called *Wings*; but we commonly call them *Iles*.

DIRECT, in Astronomy. A Planet is said to be Direct when it goes forwards by its proper Motion in the Zodiack, according to the Succession of the Signs; or when it appears so to do to an Observer standing upon the Earth.

DIRECT ERECT EAST and WEST DIALS, are Dials drawn upon Planes, that directly face the East and West, or are parallel to the Meridian of the Place.

These Dials shew the Hour but from Sun-rising to Noon, or from Noon to the Sun-setting; and the Hour-Lines are all parallel to one another, and at Distances from the Hour-Line of Six, that are equal to the Natural Tangents of the Degrees in the several Hours.

In these Dials the Style is parallel to the Plane, stands upon the Hour-Line of Six, and its Height or Distance from the Plane is equal to the Distance of the Hour-Line of Nine, from the Hour-Line of Six, or to the Radius of the said Line of Tangents, being the Distances of the Hour-Lines from the Hour-Line of Six.

DIRECT ERECT SOUTH or NORTH DIALS, are Dials drawn upon Planes that directly face the South or North, or are parallel to the Prime Vertical Circle, or to the Vertical Circle cutting the Horizon in the East and West Points.

The Sun shines upon the South Dial of this Kind, at the Time

of the Equinox, just twelve Hours, or from its Rising to its Setting. For which Reason there are twelve Hour-Lines drawn upon it: But as the Days increase in Summer, the Sun shines a less Time upon them; that is, he comes on the Dial after Six in the Morning, and goes off it before Six in the Evening; and the Proportion for finding the Time of its coming on after Six, or going off before Six, will be as Radius to the Tangent of the Latitude, so is the Tangent of the Sun's Declination to the Sine of a certain Number of Degrees, which reduced into Time will be that sought.

The Style of these Dials stands upon the Hour-Line of Twelve, and makes an Angle with the same, equal to the Complement of the Elevation of the Pole; that of the South Dial facing downwards, and that of the North upwards.

North Dials are but of little Use; for from the Time of the Autumnal Equinox to the Vernal one, the Sun does not shine upon them; but at the Vernal Equinox it begins to shine upon them, and as the Days increase, it shines longer and longer. Some few Hours from its Rising in the Morning, to a certain Time before Noon, and from a certain Time after Noon to its Setting, and the Time after Six in the Morning of its going off, will be equal to the Time of its coming on after Six in the South Dial, on any given Day in Summer; and the Time of its coming on again in Afternoon will be equal to the Time of its going off on the South Dial.

As the Radius is to the Co-Sine of the Latitude, so is the Tangent of the Angle, that any Hour-Line makes with the Hour-Line of Twelve, to the Tangent of the Plane Angle, that that Hour-Line makes with the Hour-Line of Twelve.

DIRECT SOUTH, WEST, NORTH, or EAST RECLINERS, are those Dials drawn upon Planes, which face any of the Cardinal Points of the Horizon.

DIRECT SOUTH or NORTH INCLINING DIALS, are such whose Planes incline to the Horizon, and lie directly open to the South or North.

DIRECT SOUTH or NORTH RECLINING DIALS, are such whose Planes recline from the Zenith, and lie directly to the South or North.

These Dials are described after the same Manner as Direct South Dials, the following Rule in placing the Style being only observed: In South Incliners the Difference of the Angle of Inclination and the Height of the Pole, is the Height of the Style above the Plane.

If the Height of the Pole be greater than the Angle of Inclination, then the North Pole is elevated, and the Centre is below.

If the Height of the Pole be lesser than the Angle of Inclination, then the South Pole is elevated, and the Centre is above.

In Direct North Incliners the Sum of the Angles of Inclination and Elevation of the Pole, is the Height of the Style above the Plane or Angle, that the Style makes with the Plane.

Inclining and Reclining Dials are not of much Use, being only made for compleating a Body of Dials: And after the Styles are rightly fixed, the best Way of drawing the Hour-Lines upon them, if the Body be moveable, will be to get a good regular Dial first drawn upon the Body, and when the Sun shines, move it so, that the Shadow of the Style successively falls upon the Hour-Lines; for then if Lines are drawn upon the Inclining and Reclining Planes of the Body, along the Shadows of their respective Styles, they will be the same Hour-Lines that the Shadow of the Style of the Regular Dial fell upon. But if the Body be not moveable, the Business must be done, by waiting till the Shadow of the Style of the Dial has gone over all the Hour-Lines, which may be done in one Day.

DIRECT RAY, in Opticks, is the Ray proceeding from a Point of a visible Object, directly to the Eye, through one and the same Medium.

DIRECTION, a Term in Mechanicks, wherein, by the Line of Direction, is always meant the Line of Motion, that any Body goes in, according to the Force impressed upon it.

DIRECTRIX, or *Dirigent*, a Term in Geometry, signifying the Line of Motion, along which the Describent Line, or Surface, is carried in the Genesis of any Plane or Solid Figure.

DISCONTINUAL PROPORTION. See *Discrete Proportion*.

DISCORDS, in Musick, are certain Intervals of Sounds, which

which being heard at the same Time are unpleasant to the Year; and these are the Second, Fourth, and Seventh, with their Octaves, that is, all Intervals, but those few that exactly terminate the Concords, are Discords.

Notwithstanding Discords sound unpleasant, when heard by themselves, yet being artfully mixed with Concords, they make the best Musick: And of all the Discords a Second is the most unpleasant.

DISCRETE (or Disjunct) PROPORTION, is when the Ratio of two or more Pairs of Numbers or Quantities is the same, but not continual, that is, when the Ratio of the Consequent of one Pair of Numbers, or Quantities, to the Antecedent of the next Pair, is not the same, as of the Antecedent of one Pair to its Consequent; as $3:6::8:16$ are Discrete Proportionals; because the Ratio of 3 to 6 is equal to the Ratio of 8 to 16. But the Ratio of 3 to 6, or 8 to 16, is not the same as of 6 to 8.

DISCRETE QUANTITY, is such as is not continuous, and joined together; as Numbers, whose Parts being distinct Unites cannot be united into one *Continuum*; for in a *Continuum* there are no actual Determinate Parts before Division; but they are potentially infinite.

DISDIAPASON, a Term in Musick, being a double Eighth, or Fifteenth.

DISK of the Moon, or any Planet, is the Circle made by cutting it thro' the Centre by a Plane perpendicular to a Line drawn from the Earth or Sun.

DISPART, a Term in Gunnery, signifying the Setting a

Mark upon the Muzzle Ring of a Piece of Ordnance, or thereabouts, so that a Sight-Line taken upon the Top of the Base-Rings, against the Touch-Hole, by the Mark set on or near the Muzzle, may be parallel to the Axis of the Concavity of the Piece.

This is commonly done, by taking the two Diameters of the Base-Ring, and of the Place where the Dispart is to stand, and divide the Difference between them into two equal Parts, one of which will be the Length of the Dispart, which is set on the Gun with Wax or Pitch.

DISSEMINATE VACUUM. See *Vacuum*.

DISSONANCE, in Musick, is a disagreeable Interval between two Tones, which, being continued together, offend the Ear.

DISTANCE, in Navigation, is the Number of Degrees, or Leagues, &c. that a Ship has sailed from any given Place or Point.

DISTANCE of the Eye, in Perspective, is a Line drawn from the Foot of the Altitude of the Eye to the Point, where a Line drawn at Right Angles to it will intersect the Object.

DISTANCE of the Bastions, in Fortification, is the Side of the Exterior Polygon.

DISTINCT BASE, in Opticks, is that Distance from the Pole of a Convex Glass, in which Objects beheld through it appear distinct, and well defin'd, and is what is otherwise called the *Focus*.

DISTINCT VISION. See *Vision*.

DITONE, a Double Tone, or the greater Third, is an Interval in Musick,

**Musick, which comprehends two
Tones.**

If the Tension of two equal Strings is as 4 to 5, or as 5 to 6, they will sound a Ditone, or a Semi-Ditone.

DIVERGENT POINT. See *Vertical Focus*.

DIVERGENT (or *Diverging*)
RAYs, in Opticks, are those
 Rays that, issuing from a Point
 of a Visible Object, are disper-
 sed, and continually depart from
 one another, according as they
 are removed from the Object.

DIVERGING HYPERBOLA, is one whose Legs turn their Convexities towards one another, and run contrary-ways.

DIVIDEND, in Arithmetick, is the Number that is to be divided into equal Parts by another Number.

DIVISIBILITY, is that Disposition of a Body, whereby it is conceived to have Parts, into which it may actually or mentally be divided.

Body is divisible *in Infinitum* ; that is, you cannot conceive any Part of its Extension, ever so small, but that still there may be a smaller.

There are no such Things as Parts infinitely small ; but yet the Subtility of the Parts of several Bodies is such, that they very much surpass our Conception. And there are innumerable Instances in Nature of such Parts, that are actually separated from one another.

1. Mr. Boyle mentions a Silken Thread, that was three hundred Yards long, which weighed but two Grains and a half.

2. He also said, that fifty Square Inches of Leaf Gold weighed but one Grain. Now, if an Inch

in Length be divided into two hundred Parts, the Eye may distinguish them all. Therefore, in one Square Inch there are forty thousand visible Parts; and in one Grain of Gold there are two Millions of such Parts; which may be yet further divided.

3. A whole Ounce of Silver may be gilt with eight Grains of Gold, which is afterwards drawn out into a Wire of 1300 Foot long.

4. In Odoriferous Bodies we can still perceive a greater Subtility of Parts, which are separated from one another, several Bodies scarce lose any sensible Part of their Weight in a long Time, and yet continually fill a very large Space with odoriferous Particles.

5. Dr. Keil in his *Vera Physica*,
 Left. 5. has been at the Pains to
 calculate the Magnitude of a
 Particle of *Assa Fetida*, which
 will be 57

of a Cubick Inch. And in the same Lecture he shews, that the Particles of the Blood in the Animacula, that are observed in Fluids by Means of Microscopes, must be less than that Part of a Cubick Inch which is expressed by a Fraction, whose Numerator is 8, and Denominator Unity with thirty Cyphers after it.

DIVISION, one of the four Rules of Arithmetick, is the Finding of a Number or Quantity such, from two given Numbers or Quantities, that it shall be to one of the Numbers or Quantities, as Unity is to the other.

DIVISION

DIVISION of Numbers, is only a compendious Substraction; for since the Divisor is so many times contained in the Dividend as there are Unites in the Quotient, therefore continually subtracting the Divisor from the Dividend, and accounting an Unite for each Time, the Sum of these Unites is the Quotient.

DIVISION of Proportion. If four Quantities be proportional, as $a : b :: c : d$. then the Assumption of the Difference between the Antecedents ($a - b$, or $b - a$) to either the Antecedent (a), or Consequent (b), of the first Ratio (a to b ;) and the Difference between the Antecedents ($c - d$, or $d - c$) to either the Antecedent (c), or Consequent (d) of the second Ratio c to d , is called *Division of Proportion*.

DIVISOR, in Arithmetick, is the Number that divides another, or that which shews into how many Parts the Dividend is to be divided into.

DIURNAL ARCH, is that Arch that the Sun, Moon, or Stars describe between their Rising and Setting.

DIURNAL MOTION of a Planet, is so many Degrees and Minutes, &c. as any Planet moves in twenty four Hours. And the Motion of the Earth about its Axis is called its *Diurnal Motion*.

DIURNAL PARALLAX. See *Parallax*.

DODECAGON, a Regular Polygon, consisting of twelve equal Sides and Angles; and in Fortification it is a Place with twelve Bastions.

If the Radius of a Circle, in which the *Dodecagon* is inscribed, be $= 1$, then the Side of the *Dodecagon* will be .654. And as

1 is to the Square of the Side of any given *Dodecagon*, so is 2.51956 to the Area of it.

DODECAHEDRON, is one of the Platonick Bodies, or five Regular Solids, and is contained under twelve equal and regular Pentagons.

The Solidity of a *Dodecahedron* is found by multiplying the Area of one of the Pentagonal Faces of it by 12; and then this latter Product by $\frac{1}{3}$ of the Distance of that Face from the Centre of the *Dodecahedron*, which is the same as the Centre of the Circumscribing Sphere.

The Side of a *Dodecahedron*, inscribed in a Sphere, is the greater Part of the Side of a Cube, inscribed in that Sphere, cut into Extream and Mean Proportion.

If the Diameter of the Sphere be 10000, the Side of a *Dodecahedron*, inscribed in it, will be .35682.

All *Dodecahedrons* are similar, and are to one another as the Cubes of their Sides; and their Surfaces are also similar, and therefore they are as the Squares of their Sides; whence, as .509282 is to 10.51462, so the Square of the Side of any *Dodecahedron* to the Superficies thereof; and as .3637 to 2.78516, so is the Cube of the Side of any *Dodecahedron* to the Solidity of it.

DODECATEMORY. The twelve Signs of the Zodiack. *Aries*, *Taurus*, &c. are so called, because each of them is the twelfth Part of the Zodiack.

DOME, is a round, vaulted, or arched Roof of a Church, or any great Building.

DOMINICAL LETTER, one of the first seven Letters of the Alphabet; wherewith the Sundays are mark'd through the Year in the Almanack.

If any given Year be added to one fourth Part of it, omitting Fractions, and you add 4 to the Sum, and divide the Whole by 7, and then substract 7 from the Remainder, this last Remainder shews the Order of the Dominical Letter for that Year in the Alphabet: For Example;

In the Year 1725

The fourth Part is, }
omitting Fractions, } 431

To both which add 4

The Sum is 2106

Which divided by 7, leaves 4, and 4 taken from 7, leaves 3; wherefore the Dominical Letter is C for that Year.

DONJON, in Fortification, commonly signifies a large Tower, or Redoubt of a Fortress; whence the Garison may retreat in case of Necessity, and capitulate with good Advantage.

DORICK ORDER of Architecture, is the second Order, and the most agreeable to Nature, having no Ornaments on its Base, nor its Capital. Its Column is eight Diameters high, and its Freeze is divided between Triglyphs, and Metopes.

This Order, which represents Solidity, ought not to be used but in great and massy Buildings, as the Outsides of Churches and publick Palaces.

DOUBLE DESCANT. See Descant

DOUBLE HORIZONTAL DIAL, is a Horizontal Dial of Mr.

Oughtred's, with a Double Gnomon; one to shew the Hour on the outward Circle, and the other to shew the Hour on the Stereographick Projection drawn upon it. This finds the Meridian, Hour, the Sun's Place, Rising, Setting, &c. and many other Propositions of the Globe.

DOUBLING the Cape, or a Point of Land, in Navigation, is to come up with it, pass by it, and so to leave it behind the Ship.

DOUBLE, or FLANK'D TENAILLE. See Tenaille.

DONCINE, in Architecture, is an Ornament of the highest Part of the Cornice, or a Moulding cut in Figure of a Wave, half Convex, and half Concave.

DOVETAILING, in Architecture, is the Way of fastening of Boards or Timber together, by letting of one Piece into another indently, with a Dove-tail Joint, or with a Joint in Figure of a Dove's Tail.

DRACO, a Constellation in the Northern Hemisphere; consisting of thirty three Stars.

DRAGON'S HEAD and TAIL, are the Nodes of the Moon. See Nodes.

DRAGON-BEAMS, in Architecture, are two strong Braces, or Struts, which stand under a Breast-Summer, and meet in an Angle on the Shoulder of the Key-Piece.

DRAUGHT COMPASSES, are Compasses with several moveable Points, to draw fine Draughts in Architecture, &c.

DRAUGHT HOOKS, are large Hooks fix'd on the Cheeks of a common Carriage, two on each Side, one near the Trunion Hole.

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Hole, and the other at the Train.

DRAW-BRIDGE, is a Bridge made to draw up, or let down, as Occasion serves, before the Gate of a Town or Castle: And they are made after several Fashions; but the most common are made with Plyers, twice the Length of the Gate, and a Foot in Diameter. The inner Square is travers'd with a Cross, which serves for a Counter-Poise; and the Chains that hang from the other Extremities of the Plyers, to lift up, or let down the Bridge, are of Brass or Iron.

DRAW, in Architecture. See *Larmier*.

DRY MOAT. See *Moat*.

DUPLICATE PROPORTION, OR RATIO, is a Ratio compounded of two Ratio's; as, the Duplicate Ratio of a to b is the Ratio of aa to bb , or of the Square of a to the Square of b .

If three Quantities are in continual Proportion, the first is to the third in the Duplicate Ratio of the first to the second; or as the Square of the first to the Square of the second.

DUPLICATION, is the Doubling of any Thing.

DUPLICATION of a Cubick, is to find the Side of a Cube that shall be equal in Solidity to a given Cube. Several have attempted to do this geometrically; but it is in vain to pretend to it, for it cannot be done without the Solution of a Cubick Equation; and so a Conick Section, or some higher Curve, must be used for determining the Problem.

DURABLE FORTIFICATION. See *Fortification*.

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DURATION, is the Idea we have of the Continuation of the Existence of any Thing.

DIALLING. See *Dial*.

DYE, or DYE, in Architecture, is any square Body, as the Trunk, or notch'd Part of a Pedestal, being that Part included between the Base and the Cornice.

DYPTERON, or DIPTERE, in the antient Architecture, was a Kind of Temple, encompassed round with a double Row of Columns; and the Psudo Diptere, or false Diptere, was the same, only this was encompassed with a single Row of Columns, instead of a double Row.

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EARTH. This Body of Land and Water, whereon we dwell, is nearly globular, the Diameter thereof, that is, of a great Circle of it, according to the *French* Mathematicians, being $7957 \frac{4189}{5280}$ *English* Miles.

1. On Supposition that the Sun's Parallax be thirty two Seconds, the Earth's mean Distance from the Sun will be 54000000 Miles. But Sir *Isaac Newton* takes the apparent Diameter of the Earth from the Sun to be twenty four Seconds; and so the Sun's Parallax twelve Seconds; and if so, the Sun's Distance will be much greater.

2. The Earth is of a prolate Spheroidal Figure, swelling out towards the Equator, and flattened or contracted towards the Poles;

Poles; so that the Diameter of it, at the Equator, is longer than the Axis by about thirty four Miles; and, upon this Account, there arises a small Inequality in the Magnitude of a Degree of Latitude; for they increase from the Equator to the Poles by nearly the eight hundredth Part. But this Difference of Increase is so very small, that in measuring Degrees by Instruments, it cannot be discover'd. Hence it also follows, that heavy Bodies do not tend directly to the Earth's Centre, unless at the Poles and Equator, but every where perpendicular to the Surface of the Spheriod.

3. The Earth's Excentricity is a hundred and sixty nine of such Parts as the Sun's Distance is a thousand. The Periodick Time of the Earth, in her Orbit, is three hundred and sixty five Days, five Hours, fifty one Minutes; the Motion about its Axis is performed in twenty three Hours, fifty six Minutes, four Seconds; and its Axis makes an Angle with the Plane of the Ecliptick of sixty six Degrees, thirty one Minutes.

4. The Earth's Horizontal Parallax to an Eye at the Sun's Surface will be sixteen Minutes; and it is nearer the Sun in *December* than it is in *June*, and consequently its Perihelium is in the Month of *December*, viz. about the third or fourth Day.

EARTH-BAGS, in Fortification are the same with Canvas-Bags. Which see.

EVAES-LATH, in Architecture, is a thick feather-edged Board, nail'd round the Eaves of a House for the lower-

most Tiles, Slates, &c. to rest upon.

EBBING and FLOWING, of the Sea. See Tides.

ECHO, is a Repetition of Sound, caused by Reflection.

ECHINUS, from the Greek *Echinos*, the Shell of a Chesnut, commonly signifies that Part of the Quarter-Round which includes the *Ovum*, or Egg, and sometimes the Quarter-Round itself.

ECLIPSE, is a Deprivation of the Light of the Sun, or some Heavenly Body, by the Interposition of another Heavenly Body between our Sight and it; as an Eclipse of the Sun is the Deprivation of its Sight, caused by the Interposition of the Body of the Moon, between our Sight and the Sun. An Eclipse of the Moon is the Deprivation of her Light, caused by the Diametrical Interposition of the Earth between the Sun and Moon.

A Total Eclipse of the Sun or Moon, is when their whole Bodies are obscur'd: And a Central Eclipse of the Moon, is when it is not only Total, but also the Centre of the Moon passes through the Centre of that Circle which is made by a Plane, cutting the Cone of the Earth's Shadow at Right Angles, with the Line joining the Centres of the Sun and Earth. A Partial Eclipse, is when Part of the Body of the Sun and Moon are only darken'd.

1. The Moon can never be eclipsed, but when she is in Opposition to the Sun, or at Full; and likewise in or near the Nodes: And the Sun, but when he is in Conjunction with the Moon,

Moon, and the Moon is in or near the Nodes.

2. The Limit for Eclipses of the Moon is about 11 deg. 40 min. on each Side of the Node: And the Limit for those of the Sun about 16 deg. 40 min. on each Side it. Also the utmost Latitude of the Moon, that can permit any Eclipse of the Moon, is about 1 deg. 2 min. And the same utmost Latitude that can permit any Solar Eclipse is about 1 deg. 32 min.

3. If you multiply the Number of Lunar Months, accomplished from that which began the 8th of *January*, N. S. in 1701. to that Month in which any New Moon falls out, and add to the Product 33890, and divide the Sum by 43200; then if the Remainder or the Difference between the Divisor and Remainder be less than 4060, there will be an Eclipse of the Sun that New Moon.

4. Likewise if you multiply the Number of Lunar Months, accomplish'd from that which began the 8th of *January*, N. S. 1701. to the New Moon preceeding any Full Moon, and to the Product add 37326, and then divide the Sum by 43200, if the Remainder or Difference between the Divisor and the Quotient be less than 2800, there will be an Eclipse of the Moon at the said Full.

5. All Eclipses of the Moon are of the same Magnitude all over the Earth, and begin and end at the same Times to all those inhabiting under the same Meridian. But Eclipses of the Sun on various Parts of the Earth, are different: They al-

ways begin on the West Side the Sun, and end on the East.

6. Dr. *Hally*, in his Tables not yet publish'd, takes notice of a Cycle, or Period, which Mr. *Whiston* says is two hundred and twenty three Synodical Months, or eighteen *Julian* Years, ten Days, (when the Cycle, or Period contains five Leap Days,) and eleven Days (when four Leap Days) seven Hours, forty three Minutes one Fourth; in which Time all Correspondent New Moons, Full Moons, and Eclipses return again. This Cycle is, by him, called the *Saros*, and is mentioned by *Pliny* in lib. 2. of his *Natural History*.

7. The principal Alteration of the Time of the Day in all Eclipses, depends upon the Excess of this Period above an even Number of Days, which is seven Hours, and forty three Minutes one Fourth; so that the Cycle puts every Correspondent Eclipse later than the foregoing almost eight Hours: And so if three of those Cycles are joined together, those odd Hours and Minutes will amount nearly to one Day, and they will nearly bring the Middle Point of the Correspondent Eclipses to the same Time in the same Place, which a single Cycle cannot do; and these three Cycles together will be fifty four Years, and thirty two or thirty three Days.

8. There will be elapsed nine hundred Years in the Time that the Moon begins to enter the Ecliptick Limit for Eclipses of the Moon on one Side, till it goes out of it on the other; in all which Time there will be fifty Periods, and Eclipses of the

the Moon each Period: And there will be elapsed twelve hundred and sixty Years from the Time that the Moon begins to enter the Ecliptick Limit for Eclipses of the Sun on one Side the Node, till it goes out of it on the other: During which long Time there will be seventy Periods, and somewhere Eclipses of the Sun each Period. After which long Spaces of Time there will be no such Eclipses for a much longer Time.

8. The Motion of the Centre of the Shadow of the Moon, in Eclipses of the Sun, is nearly right-lin'd.

9. The Dimensions of the Penumbra, or Intire Eclipse, and the Extent of the total Shadow on the Earth, are continually different, according to the different Elevations of the Sun and Moon above any particular Horizon.

10. The Figure of the Intire Penumbra, or General Eclipse, and of the Umbra, or Total Darkness, as they appear upon every Country, on account of the different Obliquity of every Horizon, is different, and will make Ovals, or Eclipses of different Species perpetually; and in the vast Penumbra it will be an Oval, being the Interfection of a Conical and Spherical Surface; but in the smaller Umbra, or Total Darkness, which is confin'd to a much narrower Compass, it very nearly approaches to the Interfection of a Conick Surface with a Plane, which is a true Ellipsis.

11. The Species of that Ellipsis depends on the same Altitude above the Horizon at the Time of total Darkness, as does the

Position of its longer Axis on the Azimuth of the Sun at the same Time. This Ellipsis, when the Sun is of a considerable Altitude, is almost an exact one; but when the Sun is near the Horizon, it will be very long, and so less exact, because the Spherical Surface of the Earth is at a Distance more remote from a Plane.

12. The perpendicular Breadth of the Shadow is neither that of the longer, nor that of the shorter Axis of the Cone of Shadow; but that of the two longest Perpendiculars, drawn from the Tangents, parallel to the Diameter; along which the Direction of the Motion is.

13. The Velocity of the Motion of the Centre of the Shadow is unequal; not only on account of the Difference of the Moon's Motion at the Beginning and Ending of the Intire Eclipse; which indeed is very inconsiderable, but chiefly by reason of the Difference of the Obliquity of the Horizon all the Way of its Passage.

14. The Duration of Solar Eclipses is different, according as their Middle happens about Six in the Morning or Evening, or about Noon, or about any intermediate Time. If that happens about Six o' Clock, Morning or Evening, the Diurnal Motion then neither much conspires with, nor opposes the proper Motion of the Centre of the Shadow; and the Duration is almost the same as it would be if the Earth had no Diurnal Motion at all. If that happens about Noon, the Diurnal Motion, most of all, conspires with that proper Motion of the Centre,

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ere, and makes the Duration of the Eclipse the longest possible. If it happens in the intermediate Times, the Diurnal Motion, in a less Degree, conspires with the other Motion, and makes the Duration of a mean Quantity, between that of other Cases: But if it happens considerably before Six o' Clock in the Morning, or after Six in the Evening, the Diurnal Motion is backward, and shortens that Duration proportionably.

ECLIPSE, is a great Circle of the Sphere, supposed to be drawn through the Middle of the Zodiac, and making an Angle with the Equinoctial (in the Points of *Aries* and *Libra*) of 23 deg. 30 min. which is the Sun's greatest Declination. But in the new Astronomy, it is that Path or Way among the Fix'd Stars that the Earth appears to describe to an Eye placed in the Sun.

This is, by some, called *Via Solis*, or the *Way of the Sun*, because the Sun, in his Annual Motion, never deviates from this Line, or as all other Planets do, more or less; from whence the Zodiac hath its Breadth.

EFFECTION, is a Word used by Geometers, in the same Sense with the Geometrical Construction of Propositions, and often of Problems and Practices; which, when they are deducible from, or founded upon some General Proposition, are called the Geometrical Effections thereunto belonging.

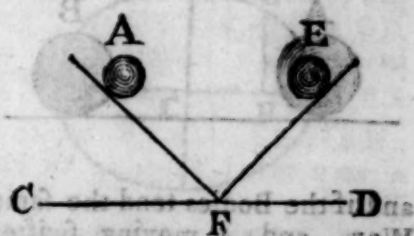
EFFLUVIUMS, are the very small Particles, or Corpuscles that are continually emitted from Bodies.

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ELASTICITY, is the same as Springiness: And an **Elastick Body** is that which gives way for a Time (or lessens its Figure) to another Body, striking or pressing it, but presently recovers its former Figure by its own natural Power: And a Body perfectly **Elastick**, is one that recovers its Figure with the Force it lost it by.

All Bodies in Nature, that we know of, are, in some Degree or other, **Elastick**, but none of them are perfectly **Elastick**; and from this Elasticity of Bodies proceeds that noted Law of Nature, viz. *That Action and Reaction are always equal and contrary*: For if there was no Elasticity, this Law would not hold good.

If the **Elastick Ball A** strikes against the firm Bottom **CD**



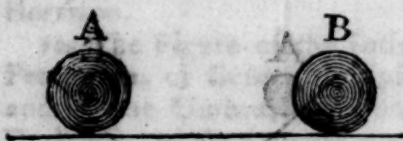
obliquely in the Direction **AF**, the Angle **EFD**, whose Side **FE** it rebounds back again in, will be equal to the Angle **AFC**.

If a String be strained like those of a Musical Instrument, it shall become **Elastick**; for the smallest Force shall be sufficient to bend it, tho' it be strained never so hard; and when that Force ceases, the Force that strains it, shall bring it back to its first Situation, and the String being once
mov'd

mov'd, shall oscillate like a Pendulum, and perform them all, both great and small, in the same Time.

Most Elastick Bodies, when struck, give a musical Sound; and the Reason why some do not, seems to be either because the Spring is too weak, and the Motion too slow, or because the Elasticity is too strong, and the Vibrating Parts so short, and the Sound so Acute, and so soon over, that it cannot be perceived by the Ear.

If the Magnitudes and Motions of Spherical Bodies perfectly Elastick, moving in the same Right Line, and meeting one another are given, their Motion after Reflection may be determin'd thus: Let the Velocities of the Bodies *A* and *B* be called *a* and *b* respectively,



and if the Bodies tend the same Way, and *A* moving swifter than *B*, follows it, then the Velocity of the Body *A* after the Reflection, will be $\frac{aA - aB + 2bB}{A + B}$

and that of the Body *B* = $\frac{2aA - bA + bB}{A + B}$.

But if the Bodies meet, than changing the Sign of *b*, the Velocities after Reflection will be $\frac{aA - aB - 2bB}{A + B}$

and $\frac{2aA + bA - bB}{A + B}$, either of which, if they happen to come

out negative, it follows that the Motion after Reflection tends the contrary way to which *A* tended before Reflection. And this is also to be understood of the Motion of the Body *A* in the former Case.

The Cause of Elasticity, in most Bodies, seems to be the repulsive Force of its Particle; for when the Elastick Body is compressed, its Pores are thereby contracted, and made smaller; so that many Particles, which were at some Distance before, are now brought nearer together, within the Sphere of each others Repulsion; which Repulsion grows stronger as the Compression increases, and the Particles are forced closer to each other: Wherefore, if the Pores of a Body are very large, it may admit of Compression without much Elasticity. And hence also, we see the Reason why the Elasticity of Metals is increased by hammering.

Sir Isaac Newton, in Prop. 23. lib. 2. Princip. demonstrates, That Particles which mutually avoid, or fly from one another by such Forces as are reciprocally proportional to the Distances of their Centres, will compose an Elastick Fluid, whose Density shall be proportional to its Compression.

ELECTRICITY, is that Property of some Bodies, as Amber, Jet, Sealing-Wax, Glass, &c. whereby they attract, or repel all Kinds of very light Bodies at a sensible Distance, when the attracting Body is heated by being rubb'd. And this Electrical Attraction is nothing else but the Attraction of Cohesion, excited by a strong Attrition

Attrition to act with less Force in a larger Sphere.

It is evident from several Experiments, that in Electrical Attraction, the Particles of Light and Ether are forcibly repelled or driven away from the Electrical Body, and that this Force reaches to a considerable Distance, but is strongest near the Electrical Body.

If a Glass Tube, fifteen or eighteen Inches long, and one Inch in Diameter, be rubbed with a Cloth, it has a very sensible Electricity; for if light Bodies, such as Pieces of Leaf Gold and Soot be laid upon a Plane, and the Tube be brought near them, they will be put in Motion, attracted, repelled, and driven several Ways by the Tube. The Tube acts at different Distances, according to the different State of the Air; some Times at the Distance of one Foot; but when the Air is full of Vapours, the Effect is diminished; and the Tube must be rubbed all one Way from the End that your Hand does not hold it with.

ELEMENTS, by Geometricians and Natural Philosophers, is usually taken for the same as Principles; and when they say the Elementary Principles of Natural or Mix'd Bodies, they mean the Simple Particles out of which the Mix'd Body is composed, and into which it is ultimately resolvable into. The Word is also used for the first Principles or Rudiments of any Science; as the *Elements of Euclid*.

ELEVATION of a Mortar-Piece, signifies the Angle which the Chase of the Piece, or the

Axis of the Cavity of the same, makes with the Horizon.

ELEVATION of the Pole, is the Number of Degrees that the Pole is raised above the Horizon of any Latitude.

ELLIPSIS, in Geometry, is a Curve Line, being the Common Section of the Superficies of a Cone, made by a Plane's cutting the Cone, so as to fall without the Base.

1. The Area of the Elliptick Space is a mean Proportional between the two Circles, having the Transverse and Conjugate Axes for their Diameters.

2. The Periphery of the Ellipsis may be obtained by the following Series.

For if CB , half of one of the Axes of an Ellipsis be $=r$, and CD , the half of the other, $=c$, and there be let fall a Perpen-



dicular GF to r , which call a ; then the Length of the Curve of the Ellipsis GB will be $=a +$

$$\frac{r^2 a^2}{6c^4} + \frac{4r^2 c^2 a^5 - r a^5}{8c^4 r^2 a^7 + r^6 a^7 - 4c^2 r^5 a^7} + \frac{40c^8}{112c^{12}} \text{ &c.}$$

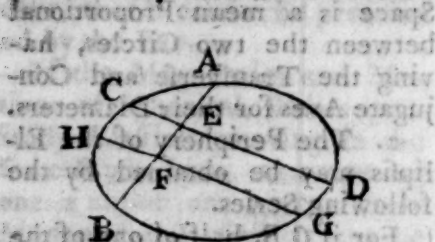
And if the Species of the Ellipsis be determined, this Series will be more simple; and if $c = 2r$, then will $BG = a +$

$$\frac{a^3}{96r^2} + \frac{3a^5}{2048r^4} + \frac{113a^7}{458752r^6} + \frac{3419a^9}{75497472r^8} \text{ &c.}$$

And

And if the said Curve was an Hyperbola, the said Series would serve for it, by making the Parts of all the Terms Affirmative, and making every third, fifth, and seventh Term Negative.

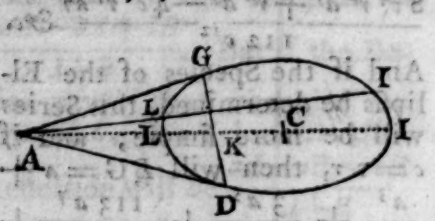
3. If any two parallel Right Lines, CD, HG , be drawn, terminating in an Ellipsis in the Points C, H, D, G , and a third Line AB , terminating in the same in the Points A, B ; then will $CE \times ED$:



$HF \times FG :: AE \times EB :: AF \times FB$.

And so, when AB and CD happen to be Conjugate Diameters, HG will be an Ordinate; and in this Case $AE = EB$, $CE = ED$, $HF = FG$. Whence $CE^2 : HF^2 :: AE^2 : AF \times FB$, which is a very noted Property of the Ellipsis.

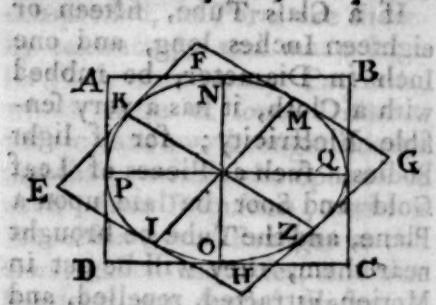
4. If any two Right Lines, touching an Ellipsis in the Points G, D , meet in the Point A , and from A be drawn the Right Line ALI , meeting the Curve in the Points L, I , and the Line GD



joining the Points of Contact in the Point K ; then will $AL : AI$

$:: KL : KI$. And so since, when the Right Line LI passes thro' the Centre C of the Ellipsis, it is bisected; therefore CK, CI, CA are Continual Proportionals. See more under *Hyperbola*.

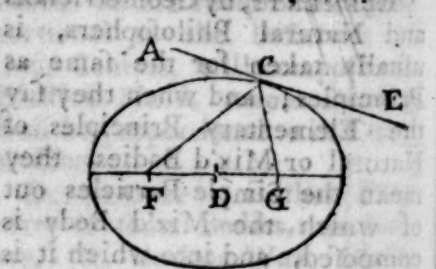
5. In every Ellipsis a Parallelogram, as $EFGH$, that circumscribes it, so that its Sides be parallel to the two Conjugate Diameters KZ, MI , is equal to



the Rectangle $ABCD$, whose Sides are equal to the two Axes, NO, PQ . See more under *Hyperbola*.

6. In every Ellipsis the Sum of the Squares of any two Conjugate Diameters is equal to the Sum of the Squares of the two Axes.

7. In every Ellipsis the Angles ACE, GCE , made by the Tan-



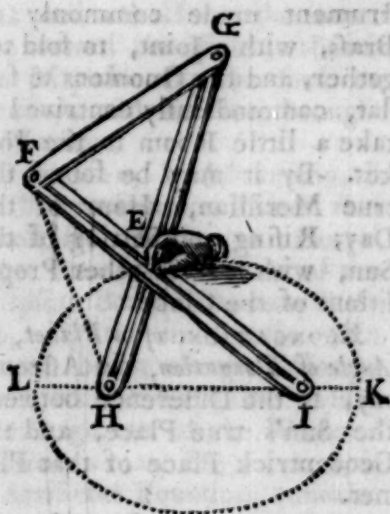
gent AE , and the Lines FC, CG , drawn from the Foci, are equal to one another.

The following Equation $ay^{n+1} = \frac{bx^n}{a-n}$ expresses the Nature of

of Infinite Ellipses, which are generated from the Section of Cones of the higher Kind. And these by some are called *Elliptoids*. If $m \sqsubset 1$, and $n \sqsubset 1$, as the Nature of a Cubical Ellipsoid is expressed by $ay^3 = \frac{bx^2}{a-x}$; and a Biquadrate or Sur-solid Ellipsoid is an Ellipsis of the third Kind, expressed by this

$$\text{Equation, } ay^4 = \frac{bx^2}{a-x^2}$$

8. If the Line LK be the transverse Axis of an Ellipsis, and Points H, I , the two Foci, and the Rulers, HG, IF , be in Length equal to LK , and the Rule FG to HI ; and if the Ends

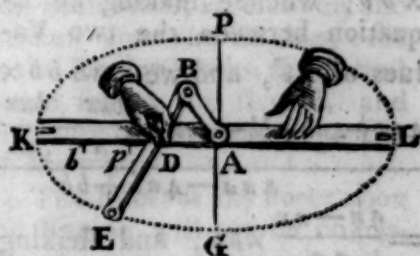
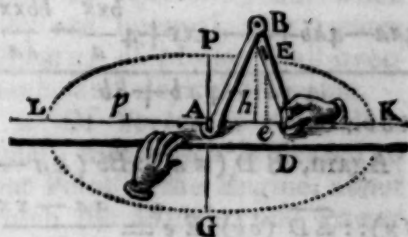


of the Rules, HG, IF , be movable about the Foci, H, I , and the Rule FG be fasten'd to them, so as to be movable about the Points, F, G ; then will the Intersection of the Rules, HG, IF , describe an Ellipsis.

That this will be an Ellipsis will appear thus. Join FH ; for because the Triangles, $FGH, F/H$, have two Sides, FG, GH ,

each equal to the two Sides, HI, IF , and the Base FH common, the Angles, FHG, HFI , will be equal; and so the Sides, FE, EH , are equal: Whence $FI = HE + EI$; but FI is equal to LK ; whence $HE + EI =$ to the Axis; and consequently the Point E is in the Ellipsis, whose Foci are H, I , and Axis LK , because the Sum of the Lines, HE, IE , in the Ellipsis, are always equal to LK .

9. If one End A of any two equal Rulers, AB, BD , which are movable about the Point B , like a Carpenter's Joint-Rule, be fasten'd to the Rule LK , so as to be movable about the Point A , and the End D of the Rule DB be drawn along the



Side of the Rule LK , any Point E , taken in the Side DB of the Rule, will describe an Ellipsis, whose Centre is A , Conjugate Axis $= 2DE$, and Transverse $= 2AB + 2BE$.

I thought it might not be amiss to lay down the following easy Analytick Demonstration of this

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this here. Call AB , or BD , x ; ED , b ; and Ab , or bD , x ; then $BD(a):ED(b)::Db(x):De=\frac{bx}{a}$: because the Triangles DEe , DBb , are supposed to be similar; and so $Ae=x-\frac{bx}{a}$, and $\overline{Ae}^2=4xx-\frac{4bxx}{a}+\frac{bbxx}{aa}$.

Now $\overline{AK}^2=\overline{AB}+\overline{BE}^2=4aa-4ab+bb$, and consequently $Le \times eK=4aa-4ab+bb-4xx+\frac{4bxx}{a}-\frac{bbxx}{aa}$, but from the Nature of the Ellipsis, $\overline{AK}^2(4aa-4ab+bb):AP^2(bb)::Le \times eK(4ab+bb-4xx+\frac{4bxx}{a}-\frac{bbxx}{aa}):e\overline{E}^2=4aa-4ab+bb-4xx+4\frac{bxx}{a}-\frac{bbxx}{aa}$
 $\frac{4aa-4ab+bb}{xbb}$.

Again, $\overline{BD}^2(aa):Bb^2(aa-xx)::\overline{ED}^2(bb):Ee^2=\frac{aa-xx}{aa} \times bb$; whence making an Equation between the two Values of Ee^2 , and we have $bb \times \frac{4aa-4ab+bb-4xx+4\frac{bxx}{a}-\frac{bbxx}{aa}}{4aa-4ab+bb}=\frac{aa-xx}{aa} \times bb$; and striking

out bb from each Side, and multiplying crosswise, we shall have $4a^4-4a^3b+aaab-4aaxx+4abxx-bbxx$ on each Side.

ELLIPTICAL COMPASS, is an Instrument for drawing of Ellipses at one Revolution of the Index, and consist of a Cross, $ABGH$, with Grooves in it;

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and an Index CE , which is fasten'd to the Cross by means



of Dove-tails at the Places C, D , that slide in the Grooves; so that when the Index is turned about, the End E thereof will describe an Ellipsis.

ELLIPTICAL DIAL, is an Instrument made commonly of Brass, with a Joint, to fold together, and the Gnomons to fall flat, commodiously contrived to take a little Room in the Pocket. By it may be found the true Meridian, Hour of the Day, Rising and Setting of the Sun, with several other Propositions of the Globe.

ELONGATION of a Planet, or Angle of Elongation, in Astronomy, is the Difference between the Sun's true Place, and the Geocentrick Place of that Planet.

The utmost Elongation of Venus can be but forty five Degrees, and that of Mercury but thirty Degrees, which is the Reason this Planet is so rarely seen.

EMBOLUS, is the Sucker of a Pump, or Syringe; which, when the Pipe of the Syringe is close stopp'd, cannot be drawn up but with the greatest Difficulty; and when forced up by

by main Strength, will, on being let go, return again with great Violence.

EMBRASURE, in Architecture, is the Enlargement made in the Walls, to give more Light and greater Convenience to the Windows and Doors of a Building.

EMBRASURES, in Fortification, are the Holes in a Parapet, through which the Cannons are pointed to fire into the Moat or Field. They are generally twelve Foot Distance from one another, every one of them being from six to seven Foot wide without, and about three within. Their Height above the Platform is three Foot on that Side toward the Town, and a Foot and a half on the other Side toward the Field; that so the Muzzle may be sunk on occasion, and the Piece brought to shoot low.

EMERSION, in Astronomy, is the Time when any Planet, that is eclipsed, begins to emerge, or get out of the Shadow of the Eclipsing Body. When any Body also, lighter in Specie than Water, being thrust violently down into it, rises again, 'tis said to emerge out of the Water.

EMINENTIAL EQUATION, is an Artificial Equation, containing another Equation eminent-ly, and is used in the Investigation of the Area's of Curv'd Spaces.

EMPATTEMENT, by some, is the same with *Talus* in Fortification. Which see.

ENCIENTE, a French Term, in Fortification, signifying the whole Inclosure, Circumference, or Compass of a fortified Place, consisting either of Bastions, or not.

ENDECAGON, a plain Figure, of eleven Sides and Angles.

ENFILADE, in Fortification, signifies a Situation of Ground, which discovers a Post according to the whole Length of a Right Line, so that it can be scoured with the Cannon, and render'd almost defenceless.

Whence, to Enfile the Curtain or Rampart, is to sweep the whole Length of it with the Cannon.

ENGINE, in general, is any mechanick Instrument, composed of Wheels, Screws, Pullies, &c. by the Help of which a Body is either moved, or hinder'd from moving.

1. When the Quantities of Motion, in the Weight and Power, are equal, the Engine shall stand in *Equilibrio*; but when they are unequal, the greater Quantity of Motion shall overcome, and work the Engine.

2. Of Forces in themselves equal, that which is nearest to that Point of the Engine, about which the Weight and Power move, or upon which they sustain each other, is relatively the weakest upon the Engine; for as the Engine works, the nearest Force moves the slowest, and therefore has the least Quantity of Motion.

3. The Effect of any Force upon the Engine will not be changed, if, without changing the Line of Direction, its only placed in some other Point of the same Line. The Nature of any Engine is explained, when it is known in what Circumstances the Weight and Power will be in *Equilibrio* upon that Engine.

4. In all Engines whatsoever, the Weight and Power will be

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in *Equilibrio* when their Quantities are in the reciprocal Proportion of the Velocities, which the Working of the Engine will give them.

If an Engine be compounded of several simple Engines, the Power is to the Resistance when it counterballances it in a Ratio compounded of all the Ratios, which the Powers in each simple Engine would have to the Resistance, if they were separately applied.

ENGONASIS HERCULES, the Name given by Astronomers to one of the Northern Constellations, containing about forty eight Stars.

ENGSCOPE, the same with a *Microscope*. Which see.

ENHARMONICAL, or ENHARMONICK, in Musick, is usually applied to the last of the three Kinds, abounding in *Dieses*, which are the least sensible Divisions of a Tone. See *Diesis*.

ENNEADECATERIDES, the same with the *Golden Number*. Which see; or the Circle of the Moon.

ENNEAGON, is a Polygon of nine equal Sides.

ENTABLATURE, or ENTABLEMENT, in Architecture, signifies the Architrave, the Freeze, and the Cornice together, and is different in the different Orders.

ENVELOPE, in Fortification, is a Mount of the Earth, sometimes raised in the Ditch of a Place, and sometimes beyond it, being either in Form of a simple Parapet, or of a small Rampart, border'd with a Parapet. These Envelopes are made when one would only cover the weak Places with single

Lines, without any Design of advancing toward the Field, which cannot be done but by Works that require a great deal of Breadth, such as *Horn-Works*, *Half-Moons*, &c.

EPACT, is a Number expressing the Excess of a Solar Year above a Lunar one, and is only of Use in finding the Age of the Moon.

If the Golden Number be given, and it be divided by 3, and the Remainder be multiplied by 10, and added to the Golden Number, and from the Sum 30 be taken away, the Remainder will be the Epact.

EPAULE, in Fortification, is the Shoulder of the Bastion, or the Angle of the Face and Flank; whence that Angle is often called the *Angle of the Epaulé*.

EPAULEMENT, in Fortification, is a Side-Work, made either of Earth thrown up, of Bags of Earth, Gabions, or of Fascines and Earth; of which latter they make the Epaulements of the Places of Arms for the Cavalry behind the Trenches.

Epaulement, is used for a Demi-Bastion, and sometimes it signifies a square Orillon, which is a Mass of Earth almost square, faced and lined with a Wall, and designed to cover the Cannon of a Casemate.

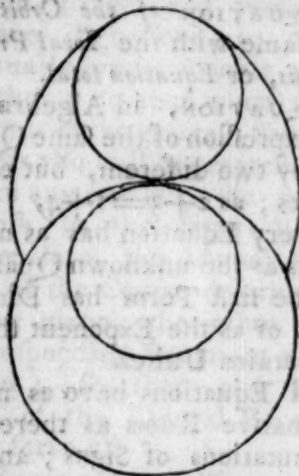
EPICYCLE, is a small Circle, whose Centre is in the Circumference of a greater, or a small Orb, which being fixed in the Deferent of a Planet, is carried along with its Motion, and yet with its peculiar Motion, carries the Body of the Planet fasten'd to it round about its proper Centre; which ancient

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Astronomers attribute to all the Planets, for solving their Appearances, except the Sun.

EPICYCLOID, is a Curve generated by a Point taken in the



Periphery of a Circle that rolls or revolves upon the Periphery of another Circle, either within or without it.

The Length of any Part of the Curve, that any given Point in the revolving Circle has describ'd from the Time it touch'd the Circle it revolv'd upon, shall be to double the vers'd Sine of half the Arch, which all that Time touch'd the Circle at rest, as the Sum of the Diameters of the Circles to the Semi-Diameter of the resting Circle, if the revolving Circle moves upon the Convex Side of the resting Circle: But if upon the Concave Side, as the Difference of the Diameters to the Semi-Diameter.

If a Parabola moves upon another equal to it, the Focus of it will describe a Right Line perpendicular to the Axis of the Parabola at rest, and at a Distance from it equal to the Distance of the Vertex from the

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Focus, and the Vertex of the Parabola will describe the Cissoid of *Diocles*, and any other Point thereof will describe some one of the defective Hyperbolas of Sir *Isaac Newton*, having a double Point in the like Point of the Parabola at rest.

If in like Manner an Ellipsis revolves upon another, equal and similar to it, the Focus will describe a Circle, whose Centre is in the other Focus, and the Radius shall be equal to the Axis of the Ellipsis; and any other Point of the Plane of the Ellipsis shall describe a Line of the fourth Order. The same may be said also of an Hyperbola, revolving upon another, equal and similar to it; for one of the Foci will describe a Circle, having its Centre in the other Focus, and the Radius shall be the principal Axis of the Hyperbola, and any other Point of the Hyperbola shall describe a Line of the fourth Order.

EPISTYLE, in Architecture, is a Mass of Stone, or Piece of Timber, laid upon the Capital of a Pillar.

EPOCHÆ, or **EPOCHÆ**, in Chronology, signifies some remarkable Occurrence, from whence some Nations date and measure their Computation of Time.

The *Julian Epochæ* takes its Name from *Julius Caesar's* Reformation of the Roman Calendar, which was done forty five Years before Christ, in the seven hundred and eighth Year from the Building of *Rome*, and in the seven hundred and thirty first Olympiad.

The *Ethiopia Abyssum*, or as some call it, the *Dioclesian Epochæ*,

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or others, the *Æra of the Martyrs*, because it bore a Date with a very severe Persecution; this *Epocha* began August 29, A. D. 284, and in the third Year of the Emperor *Dioclesian*. 'Tis used by the *Egyptians* and *Abyssyns*.

The *Turkish*, or *Arabick Epocha*, which they call the *Hegira*, bears a Date from *Mahomet's* Flight from *Mecca*, A. D. 622, July 16.

The *Persick*, or *Jesdgerdick Epocha*, takes its Date either from the Coronation of the last *Persian* King *Jesdgerdick*, or *Jesdagerdis*, as some say, or from his being conquer'd rather by *Ottoman* the *Saracen*, which was June 16. A. D. 632.

EQUABLE MOTIONS, are such as always continue the same Degree of Velocity, and are neither accelerated nor retarded; but if there be an Acceleration or Retardation of the Velocity of two or more Bodies, and it be exactly and uniformly the same in them both, or all, they say, such Bodies are

EQUABLY Accelerated or retarded.

EQUALITY, is the exact Agreement of two Things in respect of Quantity.

EQUATION, or *the total Prostaphæresis*, in the *Ptolemaic* Theory of the Planets, is the Difference between the Planets mean and true Motion, and the Angle made by the Lines of the true and mean Motion of the Centre. But the

EQUATION, or *PHYSICAL PROSTAPHÆRESIS*, is the Difference between the Motions of the Centre of the Epicycle in the Equant, and in the Eccentric. And the

EQUATION, or *OPTICAL*

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PROSTAPHÆRESIS, is the Angle made by two Lines drawn from the Centre of the Epicycle to the Centre of the World, and of the Eccentric.

EQUATION of the Orbit, is the same with the *Total Prostaphæresis*, or *Equation total*.

EQUATION, in Algebra, is an Expression of the same Quantity by two different, but equal Values; as $2+3=1+4$.

Every Equation has as many Roots as the unknown Quantity of the first Term has Dimensions, or as the Exponent thereof contains Unites.

All Equations have as many affirmative Roots as there are Permutations of Signs; and as many negative Roots as there are Successions of them; as in the Quadratick Equation $x^2+x-6=0$ there is one Succession of Signs $++$, and one Permutation $+-$. But the Equation has two Roots; one being the affirmative one $+2$, and the other the negative one -3 . Also in the Cubick Equation $x^3-3x^2-10x+24=0$ there are two Permutations of Signs $+-$ and $-+$, and one Succession $---$. But it has three Roots; two affirmative ones $+2+4$, and one negative one -3 .

EQUATION (ANNUAL) of the mean Motion of the Sun, and Moon's Apogee and Nodes.

The Annual Equation of the mean Motion of the Sun, depends upon the Eccentricity of the Earth's Orbit round him, and is sixteen $\frac{1}{12}$ such Parts, of which the mean Distance between the Sun and Earth is a thousand; from whence, by some, 'tis called the *Equation of the Centre*; and this, when greatest,

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est, is 1 deg. 56 min. 20 sec. The greatest Annual.

EQUATION of the Moon's mean Motion, is 11 min. 40 sec. of its Apogee 20 min. and of its Node 9 min. 30 sec. and these four Annual Equations are always mutually proportionable to one another; so that when any of them is at the greatest, the three others also will be greatest; and when any one less, the rest diminish in the same Ratio: Wherefore, the Annual Equation of the Centre (of the Sun) being given, the other three corresponding Equations will be given; so that one Table (*i. e.* of the Central Equation) may serve all.

EQUATION of Time, is a Space of Time to be added to, or subtracted from the Time shewn by the Sun, that thereby it may become Equable, and is the Difference between the Sun's mean Motion and its Right Ascension; and is greatest about the latter End of *January* and *October*, it being then near fifteen Minutes; and about the Beginning of *April*, *June*, and towards the latter End of *August*, it is least, being then less than a Minute.

EQUATOR. See *Equinoctial*.

EQUICRURAL. See *Isoceles*.

EQUICULUS, or EQUUS MINOR, a Constellation in the Northern Hemisphere, consisting of four Stars.

EQUILATERAL HYPERBOLA, is such an one whose transverse Diameter is equal to its Parameter; and so all the other Diameters equal to their Parameters, and the Asymptotes of it do cut one another at Right Angles in the Centre.

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EQUILATERAL TRIANGLE. See *Triangle*.

EQUILIBRIUM, in Mechanics, is when the two Ends of a Ballance hang so exactly even and level, that neither doth ascend or descend, but do both keep in a Position parallel to the Horizon, which is occasioned by their being both charged with an equal Weight.

EQUIMULTIPLES, are Numbers or Quantities multiplied by one and the same Number or Quantity. See *Proportion*.

EQUINOCTIAL, (in the Heavens,) or Equator on the Earth, is a great Circle, whose Poles are the Poles of the World. It divides the Globe into two equal Parts, that is, the Northern and Southern Hemispheres. It passes through the East and West Points of the Horizon; and at the Meridian is raised as much above the Horizon as the Complement of the Latitude of the Place.

1. Whenever the Sun cometh to this Circle, it maketh equal Days and Nights all round the Globe, because he then always rises due East, and sets due West, which he doth at no other Time of the Year, whence it hath its Name. All Stars also which are under this Circle, or which have no Declination, do always rise due East, and set full West, &c.

2. All People living under this Circle, (which, in Geography, is called the Line,) have their Days and Nights equal. At Noon the Sun is in the Zenith, or directly over their Heads, and casts no Shadow.

3. From this Circle (on the Globe) is the Declination, or

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Latitude accounted on the Meridian.

4. And the Circles which run through each Degree of Latitude or Declination, are called *Parallels of Latitude or Declination*.

5. Through this Equinoctial all the Hour-Circles are drawn at Right Angles to it; and through the Poles of the World, at every fifteenth Degree on the Celestial Globe.

6. And the Equator on the Terrestrial Globe is divided by the Meridians into thirty six equal Parts.

7. The Natural Day is measured by the Revolution of the Equator, and is ended when the same Point of the Equator comes again to the same Meridian, which is in twenty four Hours.

8. Wherefore, since the Equator (as all great Circles are) is divided into three hundred and sixty Degrees, each Hour must be $\frac{1}{24}$ of that Number, or fifteen Degrees; therefore one Degree of the Equator will contain four Minutes of an Hour, and fifteen Minutes of a Degree will make a Minute of an Hour, or sixty Seconds; and consequently four Seconds answer to one Minute of a Degree.

EQUINOCTIAL COLURE. See *Colure*.

EQUINOCTIAL DIAL, is one whose Plane is parallel to the Equinoctial.

1. The Hour-Lines on this Dial are all equally distant from one another round the Periphery of a Circle, and the Style thereof is a straight Pin, or Wire, set up in the Centre of the Circle,

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perpendicular to the Plane of the Dial.

2. The Sun shines upon the upper Part of this Dial-Plane from the 10th of *March* to the 12th of *September*, and upon the under Part the other Half of the Year.

3. There are some of these Dials made of Brass, &c. and set up in a Frame, to be elevated to any given Latitude.

EQUINOCTIAL ORIENT. See *Orient*.

EQUINOCTIAL OCCIDENT. See *Ocident*.

EQUINOXES, are the precise Times in which the Sun enters into the first Point of *Aries* and *Libra*; for the Sun moving exactly under the Equinoctial, he makes our Days and Nights equal. This he doth twice a Year, about the 10th of *March* and 12th of *September*; which therefore are called the *Vernal* and *Autumnal Equinoxes*.

1. It is found by Astronomical Observation, that the Equinoctial Points (which are the first Points of the Signs *Aries* and *Libra*) go backwards every Year 50sec.

2. And our admirable Sir *Isaac Newton*, taking the Matter into Consideration, according to his Principles, found, by Calculation, that they must recede 49 min. 58 sec. which is surprising-ly near the Truth.

3. The Space from the Vernal to the Autumnal Equinox, is eight or nine Days longer than from the Autumnal to the Vernal, by reason of the Position of the Perihelion of the Earth's Orbit near the Winter Solstice.

EQUINUS BARBATUS, a kind of Comet. See *Hippus*.

ERECT

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ERECT DECLINING DIALS. See *Declining Erect Dials*.

In Dials of this kind, as the Radius is to the Co-Sine of the Plane's Declination, so is the Co-Tangent of the Elevation of the Pole to the Sine of the Style's Height. And as the Radius is to the Sine of the Plane's Declination, so is the Co-Tangent of the Elevation of the Pole to the Tangent of the Substyle's Distance from the Meridian; and as the Radius is to the Co-Tangent of the Declination, so is the Sine of the Elevation of the Pole to the Co-Tangent of the Inclination of the Meridians; and as the Radius is to the Sine of the Styles Height :: so is the Tangent of any Hour-Angle : to the Tangent of the Hour-Arch.

ERECT DIRECT PLANES, or DIALS, are those that stand upright, and face the four Cardinal Points.

ERECT DIRECT, EAST, WEST, SOUTH, or NORTH DIALS. See *Erect Direct Planes*.

ERIDANUS, or RADUS, a Southern Constellation, consisting of twenty eight Stars.

ESCALADE, or SCALADE, is a furious Attack upon a Wall, or Rampart, carried on with Ladders to mount up upon it, without going on in Form, breaking Ground, or carrying on of Works to secure the Men.

ESPAULE, or EPAULE. See *Epaule*.

ESPAULEMENT. See *Epaulement*.

ESPLENADE, a Term in Fortification, the same with the Glacis of the Counterscarp originally; but now 'tis usually taken for the empty Space be-

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tween the Glacis of a Cittadel, and the first Houses of the Town.

ESTIVAL OCCIDENT. See *Occident*.

ESTIVAL ORIENT. See *Orient*.

ESTIVAL SOLSTICE. See *Solstice*.

EVECTION, or (being the same as) *LIBRATION of the Moon*, is an Inequality in her Motion, by which, at or near the Quadratures, she is not in a Line drawn through the Centre of the Earth to the Sun, as she is at the Syzygies, or Conjunction and Opposition, but makes an Angle with that Line of about two Degrees fifty one Minutes.

The Motion of the Moon about its Axis is only equable, it performing its Revolution exactly in the same Time as it rolls round the Earth; and thence it is that it nearly always turns the same Face towards us. But this Equality, and the unequal Motion of the Moon in her Ellipsis, is the Cause why the Moon, seen from the Earth, appears to liberate a little upon its Axis, sometimes from East to West, and sometimes from West to East; and some Parts in the Eastern Limb of the Moon go backwards and forwards a small Space, and some that were conspicuous, are hid, and then again appear.

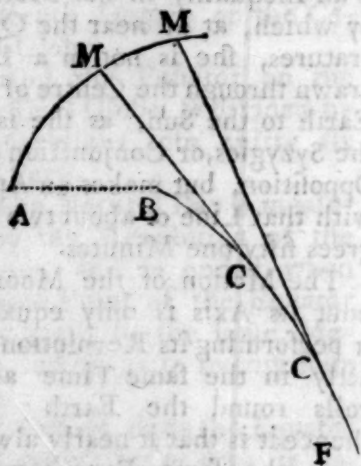
EVEN NUMBER, is that which can be divided into two equal Parts, as 4, 6, 8, &c.

EVENLY EVEN NUMBER, is that which an even Number measures by an even one, as 16 is an evenly even Number, because 8, an even Number, measures it by two, an even Number.

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EVENLY ODD NUMBER, is that which an even Number measures by an odd one, as 20, which the even Number 4 measures by the odd one 5.

EVOLUTE CURVES. If a Thread *FCM* be wrapped, or winded about the Curve *BCF*, and then unwinded again, the Point *M* thereof will describe



the Curve *AMM*, which Mr. *Hugens*, the Inventor, calls a *Curve describ'd from Evolution*; and the Curve *BCF* is the Evolute, the Part *MC* of the Thread being called the *Radius of the Evolute*.

1. When the Point *B* falls in *A*, the Radius *MC* of the Evolute is equal to the Arch *BC*; but if not, to *AB* + the Arch *BC*.

2. The Radius of the Evolute *CM* is perpendicular to the Curve *AM*.

3. Because the Radius *MC* of the Evolute continually touches it, it is evident, from the Generation of the Curve described from the Evolution, that it may be described through innumerable Points, if the Tangents in the Parts of the Evolute are produc'd until they be-

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come equal to their answerable Arches.

4. The Evolute of the common Parabola, is a Parabola of the second kind, whose Parameter is $\frac{27}{16}$ of the common Parabola.

5. The Evolute of a Cycloid, is another Cycloid equal and similar to it.

6. All the Arches of Evolute Curves are rectifiable, if the Radii of the Evolute can be expressed geometrically.

EVOLUTION, in Algebra, signifies the Extractions of the Roots of any Powers.

EURITHMY, in Architecture, is the exact Proportion between all the Parts of any Building.

EUSTYLE, is the best Manner of placing Columns, with regard to their Distance, which *Vitruvius* will have to be two Diameters and a Quarter, or four Modules.

EXAGON, the same with *Hexagon*. Which see.

EXHALATION, is any Thing that is raised up from the Earth by Heat; as Vapours, Mists, Fogs, &c.

EXHAUSTED RECEIVER, is the Vessel of Glass, &c. that stands upon the Body of the Air-Pump, in order to have the Air pump'd out of it.

EXHAUSTIONS, or the Method of Exhaustions, is the ancient Method of *Euclid*, *Archimedes*, &c. that proves the Equality of two Magnitudes by a Deduction *ad Absurdum*, in supposing, that if one be greater or less than the other, there would follow an Absurdity; and it is founded upon the first Proposition of the 10th Book of *Euclid*. See more of

E X

of this Method in *Prop. 2. 10, &c. lib. 12. Euclid.*

EXPONENT of a Ratio, is the Quotient arising from the Division of the Antecedent by the Consequent; as the Exponent

of the Ratio of 3 to 2 is $1\frac{1}{2}$, and of the Ratio of 2 to 3 is $\frac{2}{3}$. And a Row of Numbers

in an Arithmetical Progression, beginning from 0, being placed over a Rank of Geometrical Progressionals are called *Exponents*.

1. If the Consequent be Unity, the Antecedent itself is the Exponent of the Ratio.

2. The Exponent of a Ratio is to Unity, as the Antecedent is to the Consequent.

EXPONENTIAL CALCULUS. See *Calculus Exponentialis*.

EXPONENTIAL CURVE, is that whose Nature is expressed by an Exponential Equation.

The Area of any Exponential Curve, whose Nature is expressed by this Exponential Equation, $x^x = y$, (making $1 + v$

$= x$.) will be $\frac{1}{0.1.2.} v^2 +$

$\frac{1}{0.1.2.3.} v^3 - \frac{1}{0.1.2.3.4.} v^4 +$

$\frac{1}{0.1.2.3.4.5.} v^5 - \frac{1}{0.1.2.3.4.5.6.} v^6$

&c.

EXPONENTIAL EQUATION, is that wherein an Exponential Quantity enters the Equation; as $x^x = y$.

EXPONENTIAL QUANTITY, is a Quantity whose Power is a variable Quantity; as x^x , a^x .

EXTERIOR POLYGON. See *Polygon Exterior*.

EXTERIOR TALUS. See *Talus*.

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EXTERMINATION of the unknown Quantity in an Equation, is the taking it away, or getting it out of the Equation, to be exterminated.

When the unknown Quantity is of several Dimensions, it is sometimes very troublesome to get it out, and the Labour will be very much shorten'd by the following Examples, being as so many Rules.

1. From $axx + bx + c = 0$, and $fx + g = 0$, being exterminated, there comes out

$$ab - bg - 2cf \times ab + bb - cg \times bf + agg - cff \times c = 0.$$

2. From $ax^3 + bxx + cx + d = 0$, and $fx + g = 0$, x being exterminated, there comes out

$$ab - bg - 2cf \times abb + bb - cg - 2df \times bfb + cb - dg \times agg + cff + 3agb + bbg + dff \times df = 0.$$

3. From $ax^4 + bxx + cxx + dx + e = 0$, and $fx + g = 0$, x being exterminated, there comes out

$$ab - bg - 2cf \times ab^3 + bb - cg - 2df \times bfb + agg + cff \times cbb - dgb + efg - 2efb + 3agb + bbg + dff \times dfb + 2abb + 3bgb - dfg + eff \times eff - bg - 2ab \times efgg = 0.$$

4. From $ax^3 + bxx + cx + d = 0$, and $fx^3 + gx^2 + bx + k = 0$, x being exterminated, there comes out

$$ab - bg - 2cf \times aabb - acbk + ak + bb - cg - 2df \times bdfb - ak + bb + 2cg + 3df \times aakk + cdb - ddg - cck + 2bdk \times agg + cff + 3agb + bbg + dff - 3afk \times ddf - 3ak - bk + cg + df \times bcfk + bk - 2dg \times bbfk - bbk - 3adb - cdf \times agk = 0.$$

5. From $ax^3 + bxx + cx + d = 0$, and $fx^3 + gx^2 + bx + k = 0$, x being exterminated, there comes out

$$ab - bg - 2cf \times aabb - acbk + ak + bb - cg - 2df \times bdfb - ak + bb + 2cg + 3df \times aakk + cdb - ddg - cck + 2bdk \times agg + cff + 3agb + bbg + dff - 3afk \times ddf - 3ak - bk + cg + df \times bcfk + bk - 2dg \times bbfk - bbk - 3adb - cdf \times agk = 0.$$

6. From $ax^3 + bxx + cx + d = 0$, and $fx^3 + gx^2 + bx + k = 0$, x being exterminated, there comes out

$$ab - bg - 2cf \times aabb - acbk + ak + bb - cg - 2df \times bdfb - ak + bb + 2cg + 3df \times aakk + cdb - ddg - cck + 2bdk \times agg + cff + 3agb + bbg + dff - 3afk \times ddf - 3ak - bk + cg + df \times bcfk + bk - 2dg \times bbfk - bbk - 3adb - cdf \times agk = 0.$$

7. From $ax^3 + bxx + cx + d = 0$, and $fx^3 + gx^2 + bx + k = 0$, x being exterminated, there comes out

$$ab - bg - 2cf \times aabb - acbk + ak + bb - cg - 2df \times bdfb - ak + bb + 2cg + 3df \times aakk + cdb - ddg - cck + 2bdk \times agg + cff + 3agb + bbg + dff - 3afk \times ddf - 3ak - bk + cg + df \times bcfk + bk - 2dg \times bbfk - bbk - 3adb - cdf \times agk = 0.$$

8. From $ax^3 + bxx + cx + d = 0$, and $fx^3 + gx^2 + bx + k = 0$, x being exterminated, there comes out

$$ab - bg - 2cf \times aabb - acbk + ak + bb - cg - 2df \times bdfb - ak + bb + 2cg + 3df \times aakk + cdb - ddg - cck + 2bdk \times agg + cff + 3agb + bbg + dff - 3afk \times ddf - 3ak - bk + cg + df \times bcfk + bk - 2dg \times bbfk - bbk - 3adb - cdf \times agk = 0.$$

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For Example, to exterminate x out of the Equations $xx + 5x - 3yy = 0$, and $3xx - 2xy + 4 = 0$: I respectively substitute in the first Rule for abc , fg , and b , [these Quantities, viz.] $1, 5, -3yy$; $3, -2y$ and 4 ; and duly observing the Signs $+$ and $-$, there arises $4 + 10y + 18yy \times 4 + 20 - 6y^3 \times 15 + 4yy - 27yy \times -3yy = 0$, or $16 + 40y + 72yy + 300 - 90y^3 + 69y^4 = 0$.

In like manner that y may be gotten out of the Equations $y^3 - xy - 3x = 0$, and $yy + xy - xx + 3 = 0$, I substitute in the second Rule for $abcd$, fgb and x , [these Quantities] $1, -x, 0, -3x$; $1, x, -xx + 3$, and y respectively, and there comes out $3 - xx + xx \times 9 - 6xx + x^4 - 3x + x^3 + 6x \times -3x + x^3 + 3xx \times xx + 9x - 3x^3 - x^3 - 3x \times -3x = 0$. Then blotting out the superfluous Quantities, and multiplying, you have $27 - 18xx + 3x^4 - 9xx + x^6 + 3x^4 - 18x^2 + 12x^4 = 0$. And ordering (duly) $x^6 + 18x^4 - 45xx + 27 = 0$.

EXTERNAL ANGLES. See *Angles External*.

EXTRA-MUNDAN SPACE, is the infinite void Space, which, by some, is supposed to be extended beyond the Bounds of the Universe; and consequently, in which there is really nothing at all.

EXTRACTION of Roots, is the Method of finding the Root of any Number or Quantity.

EXTREME and MEAN PROPORTION is when a Line is so divided, that the Rectangle under the whole Line, and the lesser Segment is equal to the Square of the greater Segment.

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No Number can be thus divided exactly; but it will be pretty near, if you add the Square of any Number to the Square of half of it, and extract the Square Root of the Sum as near as may be; for if from this be taken half the whole Number, the Remainder is the greater Part, or Segment.

If z , the Root of any Affected Equation, be supposed to be composed of the Parts $+a$, or $-e$, and if from the Quantity $a + e$, or $a - e$, there be form'd all the Powers of z found in the given Equation, and the Numerical Quotients be respectively affix'd to them; and if the Powers to be resolv'd be subtracted from the Sum of the given Parts, and the Distance be call'd $+b$; and if, in the next Place, the Sum of all the Co-Efficients in the second Column be made equal to s ; and lastly, if in the third Column there be put down the Sum of all the Co-Efficients, which call t ; then will the

$$\text{Root } z \text{ be nearly } = a + \frac{sb}{ss + sb},$$

$$\text{or } z = \text{nearly } a + \frac{-\frac{1}{2}s \pm \sqrt{\frac{1}{4}ss + bt}}{t}.$$

If $az + bz^2 + cz^3 + dz^4 + ez^5 + fz^6, \&c. = gy + hy^2 + iy^3 + ky^4 + ly^5 + my^6, \&c.$ then will the Root of this infinite Equation be $z = \frac{g}{a}y +$

$$\frac{b - bAA}{a}y^2 + \frac{i - 2bAB - cA^3}{a}y^3 + \frac{k - bB^2 - 2bAC - 3CAB^2 - dA^4}{a}y^4, \&c.$$

Where it must be observ'd, that every Capital Letter is equal to the Co-Efficient

of

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of each preceding Term; as the Letter *B* is equal to the Co-Efficient of $\frac{b-bA^2}{a}$.

1. The Denominator of every Co-Efficient is always *a*.

2. The first Member of each Numerator is always a Co-Efficient of the Series $gy + by^2 + iy^3$, &c. viz. the first Numerator begins with the Co-Efficient *g*, the second Numerator with the second Co-Efficient *b*, &c.

3. That in every Member after the first, the Sum of the Exponents of the Capital Letters is always equal to the Index of the Power to which this Member belongs: Thus, if you consider the Capital Letter, $k-bB^2-2bAC-3cA^2B-dA^4$,

a

which belongs to the Power y^4 , in every Member you will see that bB^2 , $2bAC$, $3cA^2B$, dA^4 ; the Sum of the Exponents of the Capital Letters is 4.

4. The Exponents of the same Letters which are written before the Capitals, express how many Capitals there are in each Member.

5. The Numerical Figures that happen in these Members, express the Number of the Permutations, which the Capital Letters of each Member are capable of.

EXTREMES (CONJUNCT,) in right Angled spherical Trigonometry, are the two Circular Parts that are next to the Middle Part. And

EXTREMES (DISJUNCT,) are the two Circular Parts remote from the assum'd Middle Part. See more of this under *Spherical Trigonometry*.

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EYE, an Organ of the Body, representing whatever is visible, and consists of five Tunicks, viz. the *Cornea*, *Sclerotica*, *Uvea*, *Choroides Retina*: And three Humours, the *Aqueous*, *Chrystalline*, and *Vitreous*.

F.

FACE, or FACADE, in Architecture, is a flat Member, which hath a great Breadth, and small Projecture; as in Architraves, &c. It also signifies the Front, or outward Part of a great Building, which immediately presents itself to view.

FACE of a Bastion, or, of the Bulwark, is the most advanced Part of a Bastion toward the Field, or the Distance comprehended between the Angle of the Shoulder, and the Flanked Angle.

FACE of a Place, is the Curtain, together with the two Flanks raised above it, and the two Faces of the Bastion that look towards one another, and flank the Angle of the Tenaile.

FACE prolonged, in Fortification, is that Part of the Line of Defence-Rasant, which lies between the Angle of the Shoulder and the Curtain; or, 'tis the Line of Defence-Rasant diminished by the Length of a Face.

FACIA, or FASCIA, signifies any flat Member, as the Band of an Architrave, &c. There are some who write *Fasce*, grounded upon the Latin Word *Fascia*, a large Turban,

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Turban, which *Vitruvius* makes use of on the like Occasion.

FACTORS, in Multiplication, the Multiplicand and Multiplier are called *Factors*, because they do make or constitute the Product.

FAINT VISION. See *Vision*.

FALCATED. The Moon, or any Planet, is said to appear falcated, when the enlightened Part appears in the Form of a Sickle, or Reaping-Hook, which is when she is moving from the Conjunction to the Opposition, or from New Moon to the Full; but from Full to a New again, the enlightened Part appears gibbous, and the dark falcated.

FALCON. See *Falcon*.

FALCONET. See *Falconet*.

FALSE ATTACK. See *Attack*.

FALSE BRAYE, in Fortification, is a small Mount of Earth four Fathom wide, erected on the Level round the Foot of the Rampart, on that Side of the Field, and separated by its Parapet from the Berm, and the Side of the Moat. 'Tis made use of to fire upon the Enemy, when he is already so far advanced, that you cannot force him back from off the Parapet of the Body of the Place; and also to receive the Ruins which the Cannons make in the Body of the Place.

FALSE POSITION. See *Position*.

FASCIA. See *Facia*.

FASCIÆ from Bands, or Swathes, are certain Places in the Disks of the Planets *Mars* and *Jupiter*, that appear lighter, or more obscure, than the rest of their Bodies, being terminated by

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Parallel Lines, and seem sometimes broader, and sometimes narrower, and do not always possess the same Place of the Disk.

A very broad, but dusky *Fascia* was observed in the Middle of the Planet *Mars* by Mr. *Hugens*, in the Year 1656.

FASCINES, or **FAGGOTS**, in Fortification, are small Branches of Trees, or Bavins, bound up in Bundles, which being mixed with Earth, serve to fill up Ditches, to make up the Parapets of Trenches, &c. Some of them are dipp'd in melted Pitch or Tar, and being set on Fire, serve to burn the Enemies Lodgments, or other Works.

FAUCON, a sort of a Cannon, whose Diameter at the Bore is five Inches and a quarter, Weight seven hundred and fifty Pound, Length seven Foot, Load two Pound and a half, Shot two Inches and a half Diameter, and two Pounds and a quarter Weight.

FAUCONET, a sort of Ordnance, whose Diameter at the Bore is four Inches and a half, Weight four hundred Pounds, Length six Foot, Load one Pound and a quarter, Shot something more than two Inches Diameter, and one Pound and a quarter Weight.

FAUSE BRAYE. See *False Braye*.

FEATHER-EDGED, is a Term used by Workmen, for such Boards as are thicker on one Edge, or Side, than on the other.

FELLOWS, in Fortification, are six Pieces of Wood, each of which form an Arch of a Circle;

cle; and these joined all together by Duledges, make the Wheel of a Gun-Carriage. Their Thickness is usually the Diameter of the Ball of the Gun they serve for, and their Breadth something more.

FELLOWSHIP, or *the Rule of Fellowship*, in Arithmetick, is a Rule that teaches how, by having the several Stocks of Persons that are Partners together in Trade given, to proportion to every one of them his due Share of Loss or Gain.

The Rule of Three, several Ways repeated, will fully answer any Question in this Rule.

For as the whole Stock (or general Antecedent): is to the Total thereby gained or lost, (which is the general Consequent): : so each Man's particular Share: is to his proper Share of Loss or Gain.

FIBRES, are the small Threads, or Filaments, of which Elastick Bodies are, or may be supposed to be made.

1. The Elasticity of Fibres consists in this, that they can be extended, and taking away the Force by which they are lengthened, they will return to the Length which they had at first.

2. Fibres have no Elasticity, unless they are extended with a certain Force.

3. When a Fibre is extended with so much Force, it loses its Elasticity.

4. The Weight by which a Fibre is increased a certain Length by its stretching, is, in the different Degrees of Tension, as the Tension itself.

5. The least Lengthnings of the same Fibres are, to one another, nearly as the Forces by

which the Fibres are lengthened. Therefore, in all the least Inflections of a Chord, Musical String, or Wire, the Sagitta is encreased and diminished in the same Ratio as the Force with which the Chord is inflected.

6. In Chords of the same Kind, Thickness, and which are equally stretched, but of different Lengths, the Lengthenings, which are produced by superadding equal Weights, are to one another, as the Lengths of the Chords. If the Forces by which the Fibres are stretched be equal, and they are inflected by equal Forces, even in that Case also the *Sagitta* will be equal, however different the Thickness be.

7. If there be two equal and similar Chords, but unequally stretched, the Squares of the Times of the Vibrations are to one another inversly, as the Weights by which the Chords are stretched.

8. Any Chords of the same kind being given, the Durations of the Vibrations may be compared together; for they are in a Ratio compounded of the inverse Ratio of the Square Roots of the Weights, by which the Chords are stretched, of the Ratio of the Lengths of the Chords, and of the Ratio of the Diameters.

FICHANT FLANK. See *Flank*.

FICHANT LINE of Defence. See *Fixed Line of Defence*.

FIELD-FORT. See *Fortin*.

FIELD-PIECES, are small Cannon, which are usually carried along with an Army in the Field; such as Three Pounders, Minions, Sakers, Six Pounders, Demi-Culverins, and Twelve Poun-

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Pounders; and these being small and light, are easily carried.

FIELD-STAFF, is a Staff carry'd by the Gunners, being about the Length of a Halbert, with a Spear at the End, which to each Side has Ears screw'd on like the Cock of a Match-lock; and the Gunners screw lighted Matches in these when they are on Duty, this being called *Arming the Field-Staff*.

FIFTH, a Term in Musick, being the same as *Diapente*. Which see.

FIGURAL (OR FIGURATE) NUMBERS, are such as do, or may represent some Geometrical Figure, in Relation to which they are always consider'd; as Triangular Numbers, Pentagonal Numbers, Piramidal Numbers, &c. Of which see more under the respective Words.

FIGURATIVE DISCANT. See *Discant*.

FIGURE, in Physicks, or Natural Philosophy, is the Surface or terminating Extremes of any Body.

FIGURE, in Conick Sections, according to *Apollonius*, is the Rectangle made under the *Latus Rectum* and *Transversum* in the Hyperbola and Ellipsis.

FIGURE, in Geometry, is a Space encompassed round on all Sides, and are either Rectilineal, Curvilineal, or Mix'd.

FIGURES, in Arithmetick, are the nine Digits, or Numerical Characters, 1, 2, 3, 4, 5, 6, 7, 8, 9, and 0.

FIGURES CURVILINEAL, are such as have their Extremities crooked; as Circles, Ellipses, &c.

FIGURES MIX'D, are such as are bounded partly by Right

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Lines, and partly by Crooked ones; as a Semi-Circle, Segment of a Circle, &c.

FIGURES PLANE, (or *Plane Surfaces*;) are such as are terminated and bounded by Right Lines only.

FIGURES RECTILINEAL, are those that have their Extremities all Right Lines, as Triangles, Quadrilaterals, &c. Polygons Regular, Irregular, &c.

FILLET, is any little Square Moulding, which accompanies or crowns a larger.

FINITE, is what hath fixed and determined Bounds or Limits set to its Power, Extent, or Duration.

FINITOR, the same with the Horizon; and 'tis so called, because the Horizon finishes or terminates your Sight, View, or Prospect.

FIRMAMENT, by some Astronomers, is taken for the Orb of the Fixed Stars, or the Height of Heaven. But more properly 'tis that Space which is expanded or appears arched over us above in the Heavens.

FIRST MOVER. See *Primum Mobile*.

FISSURES, are certain Interruptions, that horizontally or parallelly divide the several Strata, of which the Body of our Terrestrial Globe is composed.

FIXED LINE of Defence, in Fortification, is a Line drawn along the Face of the Bastion, and terminates in the Courtin.

FIXED SIGNS of the Zodiack are, by some, *Taurus*, *Leo*, *Scorpio*, and *Aquarius*, being so called, because the Sun passes them respectively in the Middle of each Quarter, when that particular Season is more settled and fixed than

than under the Sign that begins and ends in it.

FIXED STARS, are such that constantly keep at the same Distance, with respect to each other.

1. The first who composed a Catalogue of the Fixed Stars was *Hyparchus* of *Rhodes*, about a hundred and twenty Years before *Christ*, who, from his own, and the Observations of some before him, collected a thousand and twenty two Stars, according to their proper Latitudes and Longitudes: And so, in *Pliny's* Judgment, *dared to do a Thing which God himself did not approve of, in telling the Number of the Stars for Posterity, and reducing them to a Standard.*

2. *Ptolemy* augmented *Hyparchus's* Catalogue with four Stars more. And *Ulegbeigh*, the Grandson of *Tamerlane* the Great, placed a thousand and seventeen in his Catalogue, who says in his Preface, That he observed all that could be observed, besides twenty seven in the South.

3. The next who made a Catalogue was *Tycho Brahe*, of seven hundred and seventy seven Fixed Stars, from his own Observations; and would admit no Star into his Catalogue, but what he had found out, and investigated by his Instruments.

4. *Dr. Halley* was the first who observed rightly the Southern Fixed Stars at *St. Helena*, being three hundred and seventy three in Number; and computed their Places for the Year 1677.

5. *Hewelins* of *Dantzick* likewise made a Catalogue of the Fixed Stars, containing one thousand eight hundred and eighty eight in all, viz. nine hundred and

fifty known by the Antients, and six hundred and three, which he calls his own, and three hundred and thirty five of *Dr. Halley's*, which could not be seen in the Horizon of *Dantzick*.

6. But *Mr. Flamsteed's* Catalogue of Stars, contained in his *Historia Celestis*, is far more numerous and exact than any of the others; for it contains three thousand Stars; but many of them cannot be observed without a Telescope; so that you cannot observe not above a thousand by the naked Eye in the visible Hemisphere: And this seems wonderful to many, that in a serene Night, when the Moon does not shine, at first Sight the Stars seem to be innumerable: But this proceeds from the Fallaciousness of Vision, proceeding from the vehement Twinkling of the Stars, while the Eye observes them all together confusedly, and without Order.

7. Yet the Number of the Fixed Stars, observable by a Telescope, is vastly great; for direct a good Telescope to the Heavens, and there will appear great Multitudes, especially in the *Via Lactea*.

8. *Dr. Hook*, with a Telescope of twelve Feet, observed seventy eight Stars in the *Pleiades*; and with longer Telescopes he still found out more. And *Anthony Maria de Reita* affirms, that in the single Constellation of *Orion* he number'd above two thousand Stars, by Help of a Telescope.

9. Several Fixed Stars, observed by the Antients, vanish, or cannot now be seen; and new ones appear for a Time, and then vanish. The Light of some Stars also disappear, and after a stated

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ted Period they shine again : Among which is that eminent one in the *Neck of the Whale*, which for eight or nine Months is not seen ; and the other four or three Months it appears, varying its Magnitude.

10. The Fixed Stars, like the rest of the Planets, appear every Day to rise and set, and to move with a circular Motion from East to West in twenty four Hours, in Circles whose Planes are parallel to the Equator.

11. The Fixed Stars, besides their former apparent Motion round the Earth, seem to have another quite contrary to that. By this they appear to change their Longitude, or Distance, from the Beginning of *Aries* forward, according to the Order of the Signs, or to move in *Consequencia*, by a slow Motion of about one Degree in seventy Years. So that those Stars, that in *Hyparchus's* Time were in *Aries*, are now in *Taurus*, &c. And the Procession of the Terrestrial Equinoxes is the Cause of this apparent Motion.

12. The Light of the Fixed Stars is much more strong and vivid than that of the Planets, altho' their apparent Diameters are much less ; because the Stars, like the Sun, shine by their own Light, and the Planets only by the Reflexion of the Sun.

13. The Fixed Stars twinkle much more than the Planets ; because their apparent Diameters being very small, the least Atom, or Particle of Matter, floating in our Atmosphere, will hinder, for a Moment, the Stars being entirely visible ; as the thick Smoke of a Chimney will do the

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Planets themselves, which will twinkle in such a Case.

14. The Distance of the Fixed Stars from us is vastly great ; because they have no sensible Parallax arising from the annual Motion of the Earth. Tho' Mr. *Flamsteed* says, that the Annual Parallax of the Pole-Star is forty Seconds ; and Mr. *Hugens* tells us, that with Telescopes, which would magnify the apparent Diameter above a hundred Times, he could never discover any sensible Magnitude in the Fixed Stars.

FLANK, in Fortification, is that Part of the Bastion which reaches from the Courtin to the Face, and defends the opposite Face, the Flank and the Curtain.

There is also the Oblique or Second Flank, which is that Part of the Courtin, where they can see to scour the Face of the opposite Bastion ; and is the Distance between the Lines Rasant and Fitchant.

The Low, Covered, or Retired Flank, is the Platform of the Casemat, which lies hid in the Bastion.

The Flanks of a Battalion, or an Army, are its Sides.

They use also the Word to Flank in an Army, that is, to discover and fire upon its Sides.

Any Fortification, which hath no Defence right forwards, is on that Account faulty and defective ; and, to render it compleat, one Part must be made to the Flank of another. The Courtin therefore is the strongest Part of any Fortify'd Place, because it is flanked by the two Flanks at its Ends.

FLANK,

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FLANK, is also a Term of War, signifying one Side of a Battalion of an Army; as to attack the Enemy in Flank, is to discover and fire upon them on one Side.

FLANK of the Courtin, or Second Flank, is that Part of the Courtin between the Flank and the Point, where the Fichant Line of Defence terminates.

FLANK a Place, is to dispose a Bastion, or other like Work, in such Manner, that there shall be no Part of it but what is defended; so as you may from thence play upon Front and Rear. For any Fortification, that hath no Defence but just right forwards, is faulty; and to render it compleat, one Part ought to be made, to flank the other. Hence the Courtin is always the strongest Part of any Place, because 'tis flanked at each End.

FLANK (FICHANT), is that from whence a Cannon playing, fireth its Bullets directly in the Face of the opposite Bastion.

FLANK (RASANT), is the Point from whence the Line of Defence begins, from the Conjunction of which, with the Courtin, the Shot only razeth the Face of the next Bastion, which happens when the Face cannot be discovered, but from the Flank alone.

FLANK (RETIRED), or the Lower or Covert Flank, is that exterior Part thereof; which advanced Part, if it be rounded, is called the *Orillon*; so that this *Flank Retire*, as the French call it, is only the Platform of the Casemat, which lies hid in the Bastion.

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FLANKS SIMPLE, are Lines which go from the Angle of the Shoulder to the Courtin, and whose principal Function is the Defence of the Moat and Place.

FLANKED (OR DOUBLE) TENAILLE. See *Tenaille*.

FLANKING LINE of Defence. See *Rasant Line of Defence*.

FLANKING ANGLE. See *Angle*.

FLANKED ANGLE, is the Angle formed by the two Faces of the Bastion, and so forms the Point of the Bastion.

FLAT BASTION. See *Bastion*.

FLAT-BOTTOM'D MOAT. See *Moat*.

FLAT CROWN. See *Corona*.

FLIE. That Part of the Mariner's Compass on which the thirty two Winds are drawn, and to which the Needle is fasten'd underneath, they call the *Flie*.

FLOATING BRIDGE, is a Bridge made in Form of a Redoubt, consisting of two Boats, covered with Planks, which ought to be so solidly framed, as to bear both Horse and Cannon.

FLUID BODY, is that whose Parts yield to any Impression; and by yielding are easily moved one among another: And so it follows, that Fluidity arises from hence, viz. that the Parts do not strongly cohere, and that the Motion is not hinder'd by any Inequality in the Surface of the Parts.

1. Fluids agree in this with Solid Bodies, that they consist of heavy Particles, and have their Gravity proportionable to their Quantity of Matter, in any Position of the Parts.

2. The Surface of a Fluid, contained in a Vessel, to keep it from flowing out, if it be not pressed

pressed from above, or if it be equally pressed, will become plain, and parallel to the Horizon.

3. The lower Parts of Fluids are pressed by the upper: This Pressure is in Proportion to the incumbent Matter, that is, to the Height of the Liquid above the Particle that is pressed.

4. The Pressure upon the lower Parts, which arises from the Gravity of the Super-incumbent Liquid, exerts itself every Way, and every Way equally.

5. In Tubes, whether equal or unequal, whether straight or oblique, a Fluid rises to the same Height.

6. When Liquids of different Gravities are contained in the same Vessel, the heaviest lies at the lowest Place, and is pressed by the lighter, and that in Proportion to the Height of the lighter.

7. The Bottom and Sides of a Vessel, which contains a Liquid, are pressed by the Parts of the Liquid, which immediately touch them. This Action increases in Proportion to the Height of the Liquid.

8. When a Solid is immersed in a Liquid, it is pressed by the Liquid on all Sides; and that Pressure increases in Proportion to the Height of the Liquid above the Solid. Bodies very deeply immersed are equally pressed on all Sides.

9. A Body specifically heavier than a Liquid, being immersed in a Liquid, will descend.

10. A Solid specifically lighter than a Liquid, ascends to the highest Surface of the Liquid. But suppose a Solid of the same Specifick Gravity with the Li-

quid, at any Height, the Liquid will sustain the whole Body.

11. All equal Solids, but of different Specifick Gravity, when they are immersed into the same Liquid, they lose equal Parts of their Weight.

12. However the Densities of equal Bodies differ among themselves, if they be immersed in the same Liquids, the Weights which they lose are in the Ratio of their Bulks.

13. The immersed Parts of the Bodies swimming on the Surface of the same Liquor, are to one another as the Weights of the Bodies. And the Parts which descend into the Liquid, by laying on of different Weights, are to one another as those Weights.

14. If any Vessel be filled with a Liquid, and that Liquid be weighed, and if you make the same Experiment with other Liquids, their Weights will be as their Densities.

15. All Bodies moved in Fluids suffer a Resistance, which arises from two Causes: The first is the Cohesion of the Parts of the Liquid: The second is the Inertia, or Inactivity of Matter; the Retardation from the Cohesion of Parts is as the Velocity itself. The Resistance arising from the Inertia, or Inactivity of Matter, when the same Body moves through different Liquids with the same Velocities, is as the Density of the Liquid.

16. When the same Body moves through the same Liquid with different Velocities, this Resistance increases as the Square of the Velocity.

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17. The Resistance from the Cohesion of Parts in Liquids, except glutinous ones, is not very sensible. In swifter Motions the Resistance alone is to be consider'd, which is as the Square of the Velocity.

18. When a Body is moved in any Liquid, the more blunt the Body is, by that Means it is more retarded. If the Body be not immersed deep, the Resistance is to be distinguished from the Retardation. When we speak of the same Body, the one may be taken for the other.

19. From the Resistance arises a Motion contrary to the Motion of the Body; the Retardation is the Celerity, and the Resistance itself is the Quantity of Motion.

20. The Retardations of any Motions are, First, as the Squares of the Velocities; Secondly, as the Densities of the Liquids through which the Bodies are moved: Thirdly, inversly, as the Diameters of those Bodies: Lastly, inversly, as the Densities of the Bodies themselves.

21. The Resistance of a Cylinder, which moves in the Direction of its Axis, is equal to the Weight of a Cylinder made of that Liquid, through which the Body is moved, having its Base equal to the Body's Base, and its Height equal to half the Height, from which a Body falling in *Vacuo*, may require the Velocity with which the said Cylinder is moved through the Liquid.

22. When a Body, specifically heavier than a Liquid, is thrown up in it, a Body rises to a less Height than it would rise in *Vacuo* with the same Celerity.

But the Defects of the Height in a Liquid from the Heights to which a Body would rise in *Vacuo* with the same Celerities, are nearly as the Squares of the Heights in *Vacuo*.

23. The Velocity of a Liquid, at any Depth, is the same as that which a Body, falling from a Height equal to the Depth, would acquire.

24. A Liquid rises higher, if its Direction be a little inclined, than if it spouts vertically.

25. The Resistance of the Air has a sensible Effect upon the Motions of Liquids; and in small Heights, the Defects of the Heights from the Heights in *Vacuo*, are in the Ratio of the Square of the Height of the Liquid above the Hole.

26. In the greatest Heights of Spouting Liquids, greater Holes are required. In all Heights there is a certain Measure of the Hole, through which the Liquid will rise to the greatest Height possible.

27. Liquids which spout obliquely, are not retarded from so many Causes, nor so much as those that spout vertically.

28. A Liquid spouting from a Hole in the Centre, will go to the greatest Distance possible.

29. The Squares of the Quantities flowing out, are in the Ratio of the Heights of the Liquids above the Holes.

30. If through equal Holes a Liquid runs out of a Cylinder, and out of another Vessel of the same Height, (and in which the Liquid is always supplied, so as to be kept at the same Height,) in the Time in which the Cylinder is emptied, there runs out twice as much Water from

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the other Vessel as from the Cylinder.

31. Besides the Irregularities from Friction, and the Resistance of the Air, there are several others arising from the Cohesion of Parts, even in Liquors that are not glutinous.

FLUTINGS, by the *French* called *Cannelures*, are certain perpendicular Cavities cut length-ways around the Shaft of the Column, and rounded at the two Extremes. Their Number was at first limited to twenty four in the *Ionick*, and twenty in the *Dorick* Order; but that Limitation, some of our modern Architects have taken the Liberty to dispense with.

FLUX and REFLUX of the Sea. See *Tide*.

FLUXIONS, are the very small, or rather indefinitely small Particles of Quantities, being called by this Name by Sir *Isaac Newton*, who considers them as the momentaneous Increments of Quantities. For Example: Of a Line by the Flux of a Point, and of a Superficies, by the Flux of a Line, and of a Solid by the Flux of a Superficies, and the Doctrine of these infinitely small Parts, is likewise called *Fluxions*.

Fluxions are of vast Use in the Investigation of the Nature of Curves, and in the Discovery of the Quadratures of Curvilinear'd Spaces, and their Rectifications, and in performing many other admirable Effections, that can be done scarcely any other Way.

The Fluxion of any generated Quantity is equal to the Fluxions of all the several generating Terms, multiplied into the Indexes of their Powers, and into their Co-Efficients continually.

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If each Term of an Equation, whose Fluxion is required, be multiplied separately by the several Indexes of the Powers of all the flowing Quantities contained in that Term, and in every such Multiplication, if one Root or Letter of the Power be changed into its proper Fluxion, so shall the Aggregate of all the Products, connected together by their proper Signs, be the Fluxion of the Equation desired.

If the Fluxion of the Numerator of any Fraction be multiplied by the Denominator, and after it be placed with the Sign —, the Fluxion of the Denominator, then will this be the Numerator, and the Square of the Denominator will be the Denominator of the Fraction expressing the Fluxion of the given Fraction.

FLUXIONS (SECOND, THIRD, &c.) are the Fluxions of Fluxions, which are considered as flowing Quantities themselves: The second Fluxions being marked by two Points over them; Thus, \ddot{y} ; the third by three; thus, \dddot{x} ; and so on.

FLY. See *Flie*.

FLYING-PINION, is a Part of a Clock, having a Fly, or Fan, thereby to gather Air, and so to bridle the Rapidity of the Clock's Motion, when the Weight descends in the striking Part.

FOCUS of an *Ellipsis*, is a Point in the longest Axis on each Side the Centre; from each of which if any two Right Lines are drawn, meeting one another in the Periphery of the *Ellipsis*, their Sum will be always equal to the longest Axis; and so when

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an Ellipsis and its two Axes are given, and the Foci are required, you need only take half the longest Axis in your Compasses, and setting one Foot in the End of the shorter, the other Foot will cut the longer in the Focus required.

Focus of an Hyperbola, is a Point in the principal Axis within the opposite Hyperbola's; from whence, if any two Right Lines are drawn meeting in either of the opposite Hyperbola's, their Difference will be equal to the principal Axis.

Focus of a Parabola, is a Point in the Axis within the Figure, distant from the Vertex one fourth Part of the *Latus Rectum*.

Focus, in Opticks, is the Point of Convergence, or Concurrence of the Rays of Light made by the Refraction, or the Reflexion of a refracting or reflecting Substance.

1. In a Plano-Convex Glass, parallel Rays are united with the Axis, that is, the Focus is distant from the Pole of the Glass a Diameter of the Convexity, if the Segment be but thirty Degrees.

2. In double Convex-Glasses of the same Sphere, the Focus is distant from the Pole of the Glass about the Radius of the Convexity, if the Segment be but thirty Degrees.

3. The Rays that fall nearer the Axis of any Glass, are not united with it so soon as those that are farther off; and the focal Distance in a Plano-Convex Glass will not be so great when the Convex Side is towards the Object, as on the contrary.

4. In viewing any Object or Body by a Plano-Convex

Glass, the Convex Side must be turned outwards.

Focus VIRTUAL. See *Virtual Focus*.

1. In Concave Glasses, when a Ray falls from Air parallel to the Axis, the Virtual Focus, by its first Refraction, is at the Distance of a Diameter and a half of the Concavity.

2. In Plano-Concave Glasses, when the Rays fall to the Axis, the Virtual Focus is Distance from the Glass the Diameter of the Concavity.

3. In Plano-Concave Glasses, as 107 : 193 :: so is the Radius of the Concavity to the Distance of the Virtual Focus.

4. In Double Concaves of the same Sphere, parallel Rays have their Virtual Focus at the Distance of the Radius of the Concavity.

5. But whether the Concavities be equal or unequal, the Virtual Focus, or Point of Divergency of the parallel Rays is determined by this Rule: As the Sum of the Radii of both Concavities : is to the Radius of either Concavity :: so is the double Radius of either Concavity : to the Distance of the Virtual Focus.

6. In Concave Glasses, if the Point to which the incident Ray converges, be distant from the Glass farther than the Virtual Focus of parallel Rays, the Rule for finding the Virtual Focus of this Ray is this: As the Difference between the Distance of this Point from the Glass, and the Distance of the Virtual Focus from the Glass : is to the Distance of the Virtual Focus :: so the Distance of this Point of Convergence from the Glass :

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Glas: to the Distance of the Virtual Focus of this converging Ray.

7. In Concave Glasses, if the Point to which the incident Ray converges be nigher to the Glas than the Virtual Focus of parallel Rays, the Rule to find where it crosses the Axis, is this: As the Excess of the Virtual Focus more than this Point of Convergency from the Glas: is to the Virtual Focus: so the Distance of this Point of Convergency from the Glas: to the Distance of the Point where this Ray crosses the Axis.

To find the Focus of a Meniscus Glas, see under the Word *Meniscus*.

If there be a Burning-Glas of a Foot in Diameter, this will constipate or crowd together all the Rays of the Sun which fell before on the Area of a Circle twelve Inches in Diameter, into the Compass of one eighth Part of an Inch, the Area's then of the two Circles will be as 9216 to 1; and consequently the Heat of the lesser to the Heat of the greater, will be reciprocally as 9216 to 1, that is, the Heat in the Focus will exceed the Sun's common Heat at that Time 9216 Times; and this will have an Effect as great as the direct Rays of the Sun would have on a Body placed at one ninety-sixth Part of the Distance of the Earth from the Sun, or on a Planet that should move round the Sun at but a very little more than a Diameter of the Sun's Distance from him, or that would never appear farther from him than about thirty six Minutes.

FOMAHANT, a Star of the first

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Magnitude in *Aquarius*, whose Longitude is 329 deg. 17 min. Latitude 21 deg. 3 min.

FOOT-BRANK, or BANQUETTE, in Fortification, is a small Step of Earth, on which the Soldiers stand to fire over the Parapet.

FORE-STAFF. See *Cross-Staff*.

FORT, is a Castle, or Place of small Extent, fortified either by Art or Nature.

FORT-ROYAL, is that which hath twenty six Fathoms for the Line of Defence.

FORT-STAR, is a Redoubt, constituted by re-entring and salient Angles, which commonly have from five to eight Points. See more under the Word *Sconces*.

FORTIFICATION, or MILITARY ARCHITECTURE, is the Art shewing how to fortify a Place with Ramparts, Parapets, Moats, and other Bulwarks; to the End, that a small Number of Men within, may be able to defend themselves for a considerable Time against the Assaults of a numerous Army without; so that the Enemy, in attacking them, must of Necessity suffer great Loss.

Fortification is either Regular or Irregular, and with respect to Time, may be distinguished into Durable and Temporary.

FORTIFICATION (DURABLE) is that which is raised to continue a long while.

FORTIFICATION (IRREGULAR) is that where the Sides and Angles are not all uniform, equi-distant, nor equal one to another.

FORTIFICATION (REGULAR) is that which is built on a Regular Polygon, the Sides and Angles

Angles whereof are all equal; being commonly about a Musket-Shot one from another.

FORTIFICATION (TEMPORARY,) is that which is erected upon an emergent Occasion for a little Time. Such are all Sorts of Works cast up for the seizing or maintaining of a Post or Passage; as also Circumvallations, Contravallations, Redoubts, Trenches, Batteries, &c.

1. Every Place within the Fortification ought to be flanked, that is, seen side-ways, or defensible from the other Parts; so that there may be no Place in which an Enemy can lodge himself undiscovered by those that are within, and that both from the Front, the Sides, even from behind, if possible.

2. The Fortress ought to command all Places round about; and therefore all the Out-Works must be lower than the Body of the Place.

3. The Works that are most remote from the Centre of the Place, ought always to be open to those that are more near.

4. The Angle-Flanquant, or the Point of the Bastion, ought to be, at least, of seventy Degrees, or as some say, (Mr. *Vauban*,) not more than a hundred, or less than sixty.

5. The Angle of the Courtin ought never to be less than ninety, or greater than a hundred Degrees; because if it be larger, 'tis too much subject to the View of the Enemy.

6. The greater the Flank and Demigorge is, in proportion to other Things, the better, because there is both more Room to retrench in, and also because

there may be made retiring Flanks, which add very much to the Strength of a Place.

7. The Line of Defence ought never to exceed point-blank Musket-Shot, which is about a hundred and twenty, or a hundred and twenty five Fathoms.

8. The Bastions that are not too little, nor yet too excessively big, are to be preferred before others; and the Angle of a Bastion should not exceed a hundred, nor be less than sixty Degrees.

9. The greater the Angle that is made by the outward Polygon and the Face shall be, the greater is the Defence of the Face.

10. Whatsoever incloses a Durable Fortification, must be either Flank, Face, or Courtin, built so well, that the first Discharge of the Cannon may not be able to pierce through it.

11. 'Tis impossible to fortify a Triangle after the common Way, because the Angle of the Gorge is always less than ninety Degrees.

12. The acuter the Angle at the Centre is, the Place is by so much the stronger, because it will have the more Sides.

13. In a Regular Fortification the Face must never be less than half the Courtin; and the Faces of the Bastion ought to be defended by the small Shot of the opposite Flank.

14. Any Trenches are preferable to those filled with Water, especially in great Places, where Sallies, Retreats, and Succours are frequently necessary; but in small Fortresses, Water-Trenches that cannot be

drained are best, because there is no need of Sallies, Succours, &c.

FORTINES, or FIELD-FORTS, are Sconces, or little Fortresses, whose flanked Angles are generally distant one from another 120 Fathom; but their Extent and Figure are different, according to the Situation or Nature of the Ground, some of them having whole Bastions, and others only Demi-Bastions. They are made use of only for a Time, either to defend the Lines of Circumvallation, or to guard some Passage, or dangerous Post.

FRACTION, is a broken Number, signifying one or more Parts, proportionally of any Thing divided: It consists of two Numbers set one over another, with a Line between them, as $\frac{1}{2}$. In all Fractions, as the Numerator: is to the Denominator:: so is the Fraction itself; to that Whole of which it is a Fraction. Hence there may be infinite Fractions of the same Value one with another; for there may be infinite Numbers found, which shall have the same Proportion one to another.

1. When the Numerator is less than the Denominator, the Fraction is less than the Whole, and consequently is what they call a proper Fraction.

2. But when the Numerator is either equal to, or greater than the Denominator, the Fraction is called *Improper*, because 'tis equal to, or greater than the Whole. Thus $\frac{4}{4}$ is equal to 1, and $\frac{5}{4}$ is equal to 1 and $\frac{1}{4}$.

3. Fractions are single or compound.

4. Single Fractions are such as

have but one Numerator, and one Denominator, as $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$.

5. Compound Fractions, or Fractions of Fractions, are such as consist of more than one Numerator, and one Denominator, as $\frac{1}{2}$ of $\frac{1}{3}$ of $\frac{1}{4}$, and are always connected by the Word *of*.

6. All Fractions, whose Numerators and Denominators are proportional, are equal to one another. As the Fractions $\frac{2}{3}$, $\frac{4}{6}$, $\frac{6}{9}$, are all proportional.

FRAISES, in Fortification, are pointed Stakes fixed in Bulwarks made of Earth, on the one Side of the Rampart, a little below the Parapet. These Stakes, being from seven to eight Foot long, are driven in almost half Way into the Earth, and present their Points somewhat sloping toward the Field. They serve to prevent Scalades and Desertion.

FRAME, is the Out-Work of a Clock or Watch, consisting of the Plates and Pillars, and which contains in it the Wheels, and the rest of the Work.

FREESE, a Term in Architecture. See *Freeze*.

FREEZE, a large Flat-Member, which separates the Architrave from the Cornice. The Word comes from *Latin*, *Phrygio*, an Embroiderer; the Freezes being frequently adorned with Figures in Bass-Relief, somewhat in Imitation of Embroidery. The Freeze is sometimes also expressed by the Word *Zophoros*, from the *Greek*, *Zoophoros*; it being usual for Animals to be represented upon it.

FRESCO, in Architecture, is a Sort of Painting, which is made upon the Plastering of an Edifice before it be dry.

FRACTION,

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FRICTION, is the Resistance arising from the Motion of one Superficies upon another, and is caused by their Defect of Slipperiness.

Mr. Romer and De la Hire have shewn in the *French Memoirs*, that the Figures of the Teeth of Wheels ought to be Epicycloids, that so their Resistance may be the least possible. And it is a great deal of Pity that this has not hitherto been put in Practice.

FRIGID ZONES. See *Zones*.

FRONT, in Perspective, is the Orthographical Projection of an Object upon a Parallel Plane.

FRONT, in Fortification, is what the *French* call *Tenaille de Place*, and the *Face of a Place*. It is that which is comprehended between the Points of any two neighbouring Bastions, viz. the *Courtin*, and two Flanks which are raised upon the *Courtin*, and the two Faces of the Bastion, which look towards one another.

FRONT-LINE, in Perspective. See *Line of the Front*.

FRONTISPIECE. See *Portale*.

FRONTON, is a Part or Member in Architecture, which serves to compose an Ornament raised over Doors, Cross-Works, Nitches, &c. sometimes making Triangles, and sometimes Parts of a Circle. It is also called *Fasfigium* by *Vitruvius*, and *Pediment* by the *French*.

FROZEN ZONES. See *Zones*.

FRUSTUM, in Geometry, signifies a Piece cut off, or separated from any Body; as the Frustum of a Pyramid or Cone, is a Part or Piece of them cut off (usually) by a Plane parallel to the Base.

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The Solidity of the Frustum of a Pyramid with a square Base will be had, by adding the Area's of the Upper and Under Bases to a mean Proportional between them, and multiplying that Sum by one Third Part of the Height of the Frustum; and as 14 to 11, so is the Solidity of the Frustum of a square Pyramid, to the Solidity of the Frustum of a Cone, whose Diameters at Top and Bottom, are equal to the Sides of the Upper and Lower Base, and Height equal.

FUGUE, in Musick, is some Point consisting of 4, 5, 6, or any Number of Notes begun by some one single Part, and then seconded by a third, fourth, fifth, and sixth Part; if the Composition consists of so many, repeating the same, or such-like Notes; so that several Parts follow, or come in one after another in the same Manner, the leading Parts still flying before those that follow.

FUGUE-DOUBLE, is when two or more different Points move together in a Fugue, and are alternately interchanged by several Parts.

FULIGINOUS VAPOURS, by some, are thick, impure, and sooty Vapours.

FURNITURE of a Dial, are such Lines as are drawn thereon for Ornament; as the Parallels of Declination, Length of the Day, Azimuths, Points of the Compass, *Babylonish* and *Jewish* Hours, &c.

FUSAROLE, is a small round Member in Architecture, cut in Form of a Collar, with somewhat long Beads under the Echinus, or Quarter-round of Pillars.

Pillars of the *Dorick*, *Ionick*, and *Composite* Orders.

FUSE, or **FUSEL**, of a *Bomb* or *Granado-Shell*, is that which makes the whole Powder, or Composition in the Shell, take fire, to do the designed Execution. 'Tis usually a wooden Pipe or Tape filled with Wild-Fire, or some such Composition, and is designed to burn so long, and no longer, as is the Time of the Motion of the Bomb from the Mouth of the Mortar to the Place where it is to fall, which Time Mr. *Anderson* makes to be about 27 Seconds; so that the Fuse must be contrived either from the Nature of the Wild-Fire, or the Length of the Pipe which contains it, to burn just at that Time.

FUST, in Architecture, signifies the Trunk or Shaft of a Column, being that Part comprehended between the Base and the Capital. *Vitruvius* calls it *Seapus*.

FUSY, is that Part of a Watch about which the Chain or String is wrapped, and is that which the Spring draweth, being in Form commonly taper. In larger Works, going with Weights, it is Cylindrical, and is called the *Barrel*.

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GABIONS, a Term in Fortification, signifying Baskets made of Osier-Twigs, equally wide at the Top and Bottom, about four Foot in Diameter, and from five to six high; which being filled with Earth, are sometimes used as Merlons for

the Batteries, and sometimes as a Parapet for the Lines of Approach, when it is requisite to carry on the Attacks through a stony or rocky Ground, and to advance them with extraordinary Vigour. They serve also to make Lodgments in some Posts, and to secure other Places from the Shot of the Enemies, who nevertheless endeavour to set the Gabions on fire with pitched Faggots, to render them useless.

GABLE-END of a House, is the upright Triangular-End from the Cornice, or Eaves, to the Top of its Roof.

GAGE-POINT. See *Gauge-Point*.

GALLERY, in Fortification, is a Cover'd Walk, the Sides whereof are Musket-Proof, consisting of a double Row of Planks lined with Plates of Iron; the Top being sometimes covered with Earth or Turf, to hinder the Effect of the artificial Fire of the Besieged. These Galleries are frequently made use of in the Moat, already filled with Faggots and Bavins, to the End that the Miner may approach safe to the Face of the Bastion, when the Artillery of the opposite Flank is dismounted.

GARDECAUT, or **GARD-DU-CORD**, is that which stops the Fusy of a Watch when wound up, and for that End is driven up by the String. Some call it *Guard-Cock*, others *Gard-du-Gut*.

-GAUGE-POINT of a *solid Measure*, is the Diameter of a Circle, whose Area is equal to the solid Content of the same Measure; as the Solidity of a Wine-Gallon being 231 Cubick Inches, (according to *Winchester Measure*;) if

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if you conceive a Circle to contain so many Inches, the Diameter of it will be 17.15; and that will be the Gauge-Point of Wine Measure; and an Ale-Gallon containing 288 Cubick Inches, by the same Rule; the Gauge-Point for Ale-Measure will be 19.15.

GAUGING, is finding the Capacities or Contents of all Sorts of Vessels which hold Liquids, Powders, Meal, Corn, &c.

The common Rule for finding the Contents of all Ale and Wine Casks, is to take the Diameters at the Bung, and at the Head; by which you may find the Areas of the Circle there; then you must take two Thirds of the Area of the Circle at the Bung, and one Third of the Area of the Circle at the Head, and add them together into one Sum, which Sum multiply'd by the internal Length of the Cask, gives the Content in solid Inches; which you may turn into Gallons, by dividing by 282 for Ale, and 231 for Wine Gallons.

GAUGING-ROD. This Rod, whose Use is to find the Quantities of Liquors contained in any Kind of Vessels, is usually made of Box-Wood, and consists of four Rules, each a Foot long, and about three Eighths of an Inch square, joined together by three brass joints; by which Means the Rod is render'd four Foot long; when the four Rules are quite open'd, and about one Foot when they are folded together.

1. On the first Face of this Rod are placed two Diagonal Lines, one for Beer, and the other for Wine; by Means of which, the Content of any common Vessel in

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Beer or Wine Gallons may be readily found, in putting the Rod in at the Bung-hole of the Vessel, until it meets the Interfection of the Head of the Vessel, with the opposite Staves to the Bung-hole.

2. On the second Face of this Rod are a Line of Inches, and the Gauge-Line, which is a Line expressing the Areas of Circles, whose Diameters are the correspondent Inches in Ale-Gallons.

3. On the third Face are three Scales of Lines. The first is for finding how many Gallons there is in a Hoghead, when it is not full, lying with its Axis parallel to the Horizon. The second Line is for the same Use as that for the Hoghead. The third Line is to find how much Liquor is wanting to fill up a Butt when it is standing.

4. Half way the fourth Face of the Gauging-Rod are three Scales of Lines, to find the Wants in a Firkin, Kilderkin, and Barrel, lying with their Axis parallel to the Horizon.

GAZONS, in Fortification, are Pieces of fresh Earth cover'd with Grass, cut in form of a Wedge, about a Foot long, and half a Foot thick, to the Lines, Parapets, and the Transverses of Galleries.

GEMINI, one of the twelve Signs of the Zodiac, being the third in Order, also a Constellation of that Name.

GENERATING LINE, or **FIGURE**, in Geometry, is that which by its Motion or Revolution produces any other Plane or solid Figure. Thus a Right Line moved any way parallel to itself, generates a Parallelogram; round a Point

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Point in the same Plane, with one End fasten'd in that Point, it generates a Circle; one entire Revolution of a Circle in the same Plane, generates the Cycloid; the Revolution of a Semicircle round its Diameter, generates a Sphere, &c. Sir *Isaac Newton* uses the Word.

GENERATED, or GENITED QUANTITY, in a very large Sense, is taken for whatever is produced either in Arithmetick by Multiplication, Division, or Extraction of Roots; or in Geometry, by the Invention of the Contents, Areas, and Sides of Figures.

GENESIS, in Geometry, is the Formation of any Plane or Solid Figure by the Motion of some Line or Surface, which Line or Surface, is always called the *Describent*; and that Line, according to which the Motion is made, is called the *Divigent*.

GEOCENTRICK, signifies any Planet or Orb that has the Earth for its Centre, or the same Centre with the Earth.

GEOCENTRICK LATITUDE of a Planet, is the Angle which a Line, joining the Planet and the Earth, makes with the Line drawn perpendicular to the Plane of the Ecliptick.

GEOCENTRICK PLACE of a Planet, is a Point of the Ecliptick, to which the Planet seen from the Earth is referred.

GEODÆSIA, Surveying, or the Art of Measuring Land.

GEODETICAL NUMBERS, are such as are considered according to those vulgar Names or Denominations, by which Money, Weights, Measures, &c. are generally known, or particu-

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larly divided by the Laws and Customs of several Nations.

GEOGRAPHICAL MILE, is the Sea-Mile, or Minute, being one 60th Part of a Degree of a great Circle on the Earth's Surface.

GEOGRAPHY, is the Science that teaches and explains the Properties of the Earth, and the Parts thereof that depend upon Quantity.

GEOMETRICAL, or ALGEBRAICK CURVES, are those whose Ordinates and Abscisses being Right Lines, the Nature thereof can be expressed by a finite Equation, having those Ordinates and Abscisses in it.

GEOMETRICAL PLANE. See *Plane*.

GEOMETRICAL, PROGRESSION, or PROPORTION. See *Progression*.

GEOMETRICAL SOLUTION of a Problem, is when the Thing is solved according to the Rules of Geometry, and by such Lines as are truly Geometrical, and agreeable to the Nature of the Problem.

GEOMETRICK PLACE, or LOCUS. See *Locus*.

GEOMETRY, originally signifies the Art of Measuring the Earth; but it is now the Science of whatever is extended, so far as it is such, that is, of Lines, Superficies, and Solids.

GEOMETRY, very probably had its first Rise in *Egypt*, where the *Nile* annually overflowing the Country, and covering it with Mud, obliged Men to distinguish their Lands one from another by the Consideration of their Figure; and to be able also to measure the Quantity of it, and to know how to plot it, and lay it out again in its just Dimensions,

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menſions, Figure, and Proportion; after which, 'tis likely a farther Contemplation of thoſe Draughts and Figures helped them to diſcover many excellent and wonderful Properties belonging to them, which Speculation continually was improving, and is ſtill to this very Day. But the Geometry of the Antients was contain'd within narrow Bounds, as well as their other Mathematical Speculations; for it only extended to Right Lines and Curves of the firſt Kind, or Order; whereas new Lines of infinite Orders are received in Geometry, which Orders are defin'd by Equations, involving the Ordinates and Abſciſſes of Curves. And Sir *Iſaac Newton* was the firſt Perſon that gave any tolerable Account of the Nature of Curves above the Conick Sections.

Geometry is divided into Speculative and Praſtical: The former treating of the Properties of Lines and Figures; ſuch as *Euclid's Elements*, *Apollonius's Conicks*, &c. And the latter ſhews how to apply theſe Speculations to uſe in Life.

GIBBOUS, is a Term uſed in reference to the enlighten'd Parts of the Moon, while ſhe is moving from Full to the firſt Quarter, and from the laſt Quarter to the Full again; for all that Time the dark Part appears horned and falcated, and the light one bunched out convex or gibbous.

GIRDERS, in Architecture, are the largeſt Pieces of Timber in a Floor. Their Ends are uſually faſten'd into the Summer or Breſt-Summers, and the Joists are framed in at one End to the

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Girders. No Girder ſhould lie leſs than ten Inches into the Wall, and their Ends ſhould be laid in Lome, &c.

GIVEN, is a Word often uſed in Mathematicks, and ſignifies ſomething which is ſuppoſed to be known. Thus, if a Magnitude be known, or that we can find another equal to it, they ſay 'tis a Given Magnitude. If the Poſition of any Thing be ſuppoſed as known, they ſay, Given in Poſition. Thus if a Circle be actually deſcribed upon any Plane, they ſay, its Centre is Given in Poſition; its Circumference is Given in Magnitude; and the Circle both in Poſition and Magnitude. But a Circle may be Given in Magnitude only; as, when only its Diameter is Given, but the Circle not actually deſcribed. If the Kind or Species of any Figure be Given, they ſay, Given in Specie: If the Ratio between any two Quantities is known, they are ſaid to be Given in Proportion.

GLACIS, a ſloping Bank in Fortification. It ſignifies a very gentle Steepneſs; but is more eſpecially taken for that which rangeth from the Parapet of the Cover'd-Way, to the Level on the Side of the Field.

GLOBE, the ſame as Sphere. Which ſee.

When a Globe has all the Parts of the Earth and Sea drawn or delineated on its Surface, like as on a Map, and placed in their natural Order and Situation, it is called an *Artificial Terreſtrial Globe*.

But if upon the Superficies thereof be painted the Images of the Conſtellations, and the fixed

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fixed Stars, with the Circles of the Sphere, it is called an *Artificial Cœlestial Globe*.

Both these Globes, in order to shew the Nature of the Sphere, and resolve Astronomical and Geographical Problems, are fitted and movable in brass Meridians, and these Meridians are fet in Notches made in broad wooden Circles representing the Horizon.

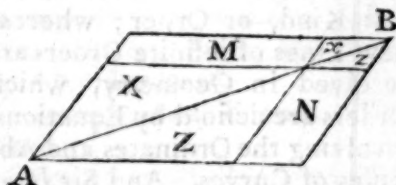
GLOBULAR-CHART, is a Name lately given to a Representation of the Surface, or some Part of the Surface of the Terraqueous Globe upon a Plane, wherein the Parallels of Latitude are Circles nearly concentrick; the Meridian's Curves bending towards the Poles, and the Rhumb-Lines also Curves.

This Chart is valuable upon this Account, *viz.* that the Distances between Places upon the Rhumb are all measured by the same Scale of equal Parts, and the Distance of any two Places in the Arch of a great Circle, is nearly represented in this Chart by a straight Line; and so, if Land-Maps were made according to this Projection, they would, in my Opinion, be better than those that are made any other Ways whatsoever. But this Chart will never be of so excellent Use to Seamen, as *Mercator's*; because the Meridians, Parallels, and particularly the Rhumb-Lines, being all Curves in the Globular Chart, but straight Lines in that of *Mercator*; straight Lines are vastly more easy to draw and manage than Curves, especially such as the Rhumb-Lines on the Globular-Chart, are.

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This Projection is not new, but on the contrary very ancient; for it is mention by *Ptolemy* in his *Geography*; as also by *Blundivill* in his *Exercises*.

GNOMON, in a Parallelogram, is a Figure made of the two Complements, together with either of the Parallelograms about the Diagonal; as in the Parallelogram *AB*, the Gnomon is $M+x+Z+N$, or $M+N+X+Z$.



GNOMON, in Dialling, is the Style, Pin, or Cock of any Dial, whose Shadow shews the Hour. The Gnomon of every Dial represents the Axis of the World.

GNOMONICK PROJECTION of the Sphere, is the Representation of the Circles of the Sphere, upon a Plane that touches the Sphere, or else on one that does not cut it, the Eye being supposed in the Centre of the Sphere.

In this Projection, (which all Plain Sun-Dials may be said to be of, from whence it derives its Name, *viz.* from Gnomonicks, or Dialling, all the great Circles of the Sphere are represented by straight Lines, of an indeterminate Length. All lesser Circles, parallel to the Plain of Projection, will be Circles; and all lesser Circles, oblique to the Pro-

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Projection Plane, will be either Parabola's, Ellipses, or Hyperbola's, according to their different Obliquity.

GNOMONICKS. The same with *Dialling*.

GOLDEN NUMBER. See *Cycle of the Moon*.

If 1 be added to the Year, and the Sum be divided by 19, the Remainder, after Division, is the *Golden Number*.

GOLDEN RULE. See *Rule of Three*.

GORGE, GULLA, or NECK, in Architecture, is the narrowest Part of the *Tuscan* or *Dorick* Capitals, lying between the Astragal, above the Shaft of the Pillar, and the Annulets. It is also a kind of concave Moulding, larger, but not so deep as a *Scotia*, which serves for Compartments, &c.

GORGE, in Fortification, is the Entrance of the Platform of any Work.

GORGE, in all other Outworks, is the Interval betwixt the Wings on the Side of the great Ditch. But it ought to be observed, that all the Gorges are destitute of Parapets; because, if there were any, the Besiegers, having taken Possession of a Work, might make use thereof, to defend themselves from the Shot of the Place; so that they are only fortified with Pallisadoes, to prevent a Surprise.

GORGE of a Bastion, is nothing else but the prolonging of the Courtins from their Angle with Flanks, to the Centre of the Bastion where they meet; but when the Bastion is flat, its Gorge is a Right Line, which

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terminates the Distance comprehended between two Flanks.

GORGE of the Ravelin, or of a Half-Moon, is the Space contained between the Extremities of the two Faces on the Side of the Place.

GOTHICK (or MODERN) ARCHITECTURE, is that which is far removed from the Manner and Proportions of the Antique, having its Ornaments wild and chimerical, and its Profiles incorrect. However, it is oftentimes found very strong, and appears very rich and pompous, as particularly in several *English* Cathedrals. This Manner of Building came originally from the North, whence it was brought by the *Goths* into *Germany*, and has since been introduced into other Countries.

GRANADO, is a little hollow Globe, or Ball of Iron, or other Metal, about two Inches and a half in Diameter, which, being filled with fine Powder, is set on Fire by the Means of a small Fusée, fastened to the Touch-Hole: As soon as it is kindled, the Case flies into many Shatters, much to the Damage of all that stand near. These Granadoes serve to fire close and narrow Passages, and are often thrown with the Hand among the Soldiers, to disorder their Ranks; more especially in those Posts where they stand thickest, as in Trenches, Redoubts, Lodgments, &c.

GRAVITY, is that Force by which Bodies are carried, or tend towards the Centre of the Earth.

GRAVITY (ABSOLUTE,) is the whole Force by which any Body

dy tends towards the Centre of the Earth.

GRAVITY (ACCELERATE,) is the Force of Gravity consider'd, as growing greater, the nearer it is to the attracting Body or Point.

GRAVITY (RELATIVE,) is the Excess of the Gravity in any Body, above the Specifick Gravity of a Fluid it is in.

GRAVITATION, is a Pressure, that a Body, by the Force of its Gravity, exerts on another Body under it.

1. All Bodies are mutually heavy, or gravitate mutually towards each other; and this Gravity is proportional to the Quantity of Matter; and at unequal Distances it is inversly, as the Square of the Distance. And so the Sun and Planets mutually gravitate towards each other; the Satellites of *Jupiter* and *Jupiter*; the Satellites of *Saturn* and *Saturn*; and the Moon and the Earth.

2. On the Surfaces of Bodies that are Spherical and Homogeneous, the Gravities will be in the Ratio compounded of the Densities and the Diameters.

3. If a Body be placed in a Sphere that is Homogeneous, Hollow, and every where of the same Thickness, it has no Gravity, let it be placed where it will.

4. In an Homogeneous Sphere, Gravity decreases in coming towards the Centre, in the direct Ratio of the Distance from the Centre.

5. By Gravity all Bodies descend towards a Point, which either is, or is very near to the Centre of Magnitude of the Earth and Sea, about which the

Sea forms itself into a Spherical Surface; and the Prominences of the Land, considering the Bulk of the Whole, differ but insensibly therefrom.

6. This Point or Center is fixed within the Earth, or at least hath been so ever since we have any Authentick History. For a Consequence of its Shifting, tho' never so little, would be overflowing of the Low-Land on that Side of the Globe towards which it approached.

7. In all Places equi-distant from the Centre of the Earth, the Force of Gravity is nearly equal.

8. Gravity equally affects all Bodies, without Regard to their Bulk, Figure, or Matter; so that abstracting from the Resistance of the Medium, the most compact and loose, the greatest and smallest Bodies would descend equal Spaces in equal Times, as appears from the quick Descent of very light Bodies in the Exhausted Receiver.

9. There are various Opinions of Philosophers concerning the Cause of Gravity; but the most probable is, that of a very subtile Fluid, which encompasses the Earth and Air, that freely pervades the Pores of all Bodies: For the Endeavours of such a Fluid to detruce all earthly Bodies from it, together with some other Properties, may make all Bodies move towards the Centre of the Earth: And that there is such a Fluid, is shewn by Experiments.

10. Sir *Isaac Newton*, in his *Opticks*, the last Edition, proposes the following Queries concerning that subtile Medium, which

which is the Cause of the Gravity and Attraction of Bodies:

1. If in two large tall Cylindrical Vessels of Glass inverted, two little Thermometers be suspended, so as not to touch the Vessels, and the Air be drawn out of one of these Vessels, and these Vessels thus prepared be carried out of a cold Place into a warm one, the Thermometer *in Vacuo* will grow warm as much, and almost as soon as the Thermometer which is not *in Vacuo*; and when the Vessels are carried back into a cold Place, the Thermometer *in Vacuo* will grow cold almost as soon as the other Thermometer. Is not the Heat of the warm Room conveyed through the Vacuum by the Vibrations of a much subtler Medium than Air, which, after the Air was drawn out, remained in the Vacuum? And is not this Medium the same with that Medium by which Light is refracted and reflected? and by whose Vibrations Light communicates Heat to Bodies, and is put into Fits of easy Reflexion and easy Transmission? And do not the Vibrations of this Medium in hot Bodies contribute to the Intensity and Duration of their Heat? And do not hot Bodies communicate their Heat to contiguous cold ones, by the Vibrations of this Medium, propagated from them into cold ones? And is not this Medium exceedingly more rare and subtle than the Air, and exceedingly more elastic and active? And doth it not readily pervade all Bodies? And is it not (by its elastic Force) expanded through all the Heavens?

2. Doth not the Refraction of

Light proceed from the different Density of this Æthereal Medium in different Places, the Light receding always from the denser Parts of the Medium? And is not the Density thereof greater in free and open Spaces, void of Air, and other grosser Bodies, than within the Pores of Water, Glass, Chrystal, Gems, and other compact Bodies? For when Light passes through Glass, or Chrystal, and falling very obliquely upon the farther Surface thereof, is totally reflected, the total Reflection ought to proceed rather from the Density and Vigour of the Medium without, and beyond the Glass, than from the Rarity and Weakness thereof.

3. Doth not this Æthereal Medium in passing thro' Water, Glass, Chrystal, and other compact and dense Bodies into empty Spaces, grow denser and denser by Degrees, and by that Means refract the Rays of Light not in a Point, but by bending them gradually in Curve-Lines? And doth not the gradual Condensation of this Medium extend to some Distance from the Bodies, and thereby cause the Inflexions of the Rays of Light, which pass by the Edges of dense Bodies, at some Distance from the Bodies?

4. Is not this Medium much rarer within the dense Bodies of the Sun, Stars, Planets, and Comets, than in the empty Celestial Spaces between them? And in passing from them to great Distances, doth it not grow denser and denser perpetually, and thereby cause the Gravity of those great Bodies towards one another, and of their Parts towards the Bodies; every Body endeavouring to go from the denser

denser Parts of the Medium towards the rarer? For if this Medium be rarer within the Sun's Body than at its Surface, and rarer there than at the hundredth Part of an Inch from its Body, and rarer there than at the fiftieth Part of an Inch from its Body, and rarer there than at the Orb of Saturn, I see no Reason why the Increase of Density should stop any where, and not rather be continu'd through all Distances from the Sun to Saturn, and beyond. And though this Increase of Density may at great Distances be exceeding slow, yet, if the elastick Force of this Medium be exceeding great, it may suffice to impel Bodies from the denser Parts of the Medium towards the rarer, with all that Power which we call *Gravity*. And that the elastick Force of that Medium is exceeding great, may be gathered from the Swiftmess of its Vibrations. Sounds move about 1140 *English* Feet in a second Minute of Time, and in seven or eight Minutes of Time they move about one hundred *English* Miles. Light moves from the Sun to us in about seven or eight Minutes of Time, which Distance is about 70000000 *English* Miles; supposing the Horizontal Parallax of the Sun to be about 12 sec. And the Vibrations or Pulses of this Medium, that they may cause the alternate Fits of easy Transmission and easy Reflexion, must be swifter than Light, and by Consequence above 700000 Times swifter than Sounds. And therefore the elastick Force of this Medium, in proportion to its Density, must be above 700000×700000 (that is above

490000000000) Times greater than the elastick Force of the Air, is in proportion to its Density. For the Velocities of the Pulses of elastick Mediums are in a subduplicate Ratio of the Elasticities and the Rarities of the Mediums taken together.

5. As Attraction is stronger in small Magnets than in great ones, in proportion to their Bulk; and Gravity is greater in the Surfaces of small Planets than in those of great ones, in proportion to their Bulk; and small Bodies are agitated much more by electrick Attraction than great ones; so the Smallness of the Rays of Light may contribute very much to the Power of the Agent, by which they are refracted. And so, if any one should suppose that *Æther* (like our Air) may contain Particles, which endeavour to recede from one another, (for I do not know what this *Æther* is,) and that its Particles are exceedingly smaller than those of Air, or even those of Light: The exceeding Smallness of its Particles may contribute to the Greatness of the Force, by which those Particles may recede from one another, and thereby make that Medium exceedingly more rare and elastick than Air, and by Consequence exceedingly less able to resist the Motions of Projectiles, and exceedingly more able to press upon gross Bodies, by endeavouring to expand itself.

6. May not Planets and Comets, and all gross Bodies, perform their Motions more freely, and with less Resistance in this *Æthereal* Medium, than in any Fluid, which fills all Space adequately

quately, without leaving any Pores, and by Consequence is much denser than Quicksilver or Gold? And may not its Resistance be so small, as to be inconsiderable? For Instance, If this *Æther* (for so I will call it) should be supposed 700000 Times more elastick than our Air, and above 700000 Times more rare, its Resistance would be above 600000000 Times less than Water? And so small a Resistance would scarce make any sensible Alteration in the Motions of the Planets in ten thousand Years. If any one would ask how a Medium can be so rare, let him tell me how the Air, in the upper Parts of the Atmosphere, can be above an hundred thousand thousand Times rarer than Gold? Let him also tell me how an electrick Body can, by Friction, emit an Exhalation so rare and subtile, and yet so potent, as by its Emission to cause no sensible Diminution of the Weight of the electrick Body, and to be expanded through a Sphere, whose Diameter is above two Feet, and yet to be able to agitate and carry up Leaf-Copper, or Leaf-Gold, at the Distance of above a Foot from the electrick Body? And how the Effluvia of a Magnet can be so rare and subtile, as to pass through a Plate of Glass, without any Resistance, or Diminution of their Force, and yet so potent, as to turn a Magnetick Needle beyond the Glass?

7. Is not Vision performed chiefly by the Vibrations of this Medium, excited in the Bottom of the Eye, by the Rays of Light, and propagated through

the solid, pellucid, and uniform Capillamenta of the Optick Nerves into the Place of Sensation? And is not Hearing performed by the Vibrations either of this or some other Medium, excited in the auditory Nerves by the Tremors of the Air, and propagated through the solid, pellucid, and uniform Capillamenta of those Nerves into the Places of Sensation? And so of the other Senses.

8. Is not animal Motion performed by the Vibrations of this Medium, excited in the Brain by the Power of the Will, and propagated from thence through the solid, pellucid, and uniform Capillamenta of the Nerves into the Muscles, for contracting and dilating them? I suppose that the Capillamenta of the Nerves are each of them solid and uniform, that the vibrating Motion of the *Æthereal* Medium may be propagated along them from one End to the other uniformly, and without Interruption; for Obstructions in the Nerves create Palsies. And that they may be sufficiently uniform, I suppose them to be pellucid, when viewed single, tho' the Reflections in their Cylindrical Surfaces may make the whole Nerve (composed of many Capillamenta) appear opaque and white; for Opacity arises from Reflecting Surfaces, such as may disturb and interrupt the Motions of this Medium.

9. The Parts of all homogeneous hard Bodies, which fully touch one another, stick together very strongly: And for explaining how this may be, some have invented Hooked

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Atoms, which is begging the Question; and others tell us, that Bodies are glued together by rest, that is, by an occult Quality, or rather by nothing; and others, that they stick together by conspiring Motions, that is, by relative Rest amongst themselves. I had rather infer from their Cohesion, that their Particles attract one another by some Force, which, in immediate Contract, is exceeding strong, at small Distances performs the Chymical Operations of Fermentation, &c. and reaches not far from the Particles with any sensible Effect.

10. All Bodies seem to be composed of hard Particles; for otherwise Fluids would not congeal.

11. Even the Rays of Light seem to be hard Bodies.

12. Now if Compound Bodies are so very hard, as we find some of them to be, and yet are very porous, and consist of Parts which are only laid together, the simple Particles which are void of Pores, and were never yet divided, must be harder; for such hard Particles being heaped up together, can scarce touch one another in more than a few Points, and therefore must be separable by a much less Force than is requisite to break a solid Particle, whose Parts touch in all the Space between them, without any Pores or Interstices to weaken their Cohesion. And how such very hard Particles, which are only laid together, and touch only in a few Points, can stick together, and that so firmly as they do, without the Assistance of something which causes them to be

attracted or press'd towards one another, is very difficult to conceive.

13. The same Thing I infer also from the cohering of two polished Marbles *in Vacuo*, and from the standing of Quicksilver in the Barometer at the Height of fifty, sixty, or seventy Inches, or above, whenever it is well purged of Air, and carefully poured in, so that its Parts be every where contiguous, both to one another, and to the Glass. The Atmosphere by its Weight presses the Quicksilver into the Glass, to the Height of twenty nine or thirty Inches: And some other Agent raises it higher, not by pressing it into the Glass, but by making its Parts stick to the Glass, and to one another; for upon any Discontinuation of Parts, made either by Bubbles, or by shaking the Glass, the whole Mercury falls down to the Height of twenty nine or thirty Inches.

14. Moreover, if two Plain polished Plates of Glass (suppose two Pieces of a polished Looking Glass) be laid together, so that their Sides be parallel, and at a very small Distance from one another, and then their lower Edges be dipped into Water, the Water will rise up between them; and the less the Distance of the Glasses is, the greater will be the Height to which the Water will rise. If the Distance be about the hundredth Part of an Inch, the Water will rise to the Height of about an Inch; and if the Distance be greater or less in any Proportion, the Height will be reciprocally proportional to the Distance, very nearly:

nearly: For whether the Distance between them be greater or less, and the Weight of the Water drawn up is the same, if the Height of it be reciprocally proportional to the Height of the Glasses. And, in like Manner, Water ascends between two Marbles, polished plain, when their polished Sides are parallel, and at a very little Distance from one another: And if slender Pipes of Glass be dipped at one End into Stagnating Water, the Water will rise up within the Pipes, and the Height to which it arises will be reciprocally proportional to the Diameter of the Cavity of the Pipe, and will be equal to the Height to which it rises between two Planes of Glass, if the Semi-Diameter of the Cavity of the Pipe be equal to the Distance between the Planes, or thereabouts. And these Experiments succeed after the same Manner *in Vacuo*, as in the open Air, (as hath been tried before the Royal Society,) and therefore are not influenced by the Weight or Pressure of the Atmosphere.

15. If two plain polished Plates of Glass, three or four Inches broad, and twenty or twenty five long, be laid, one of them parallel to the Horizon, the other upon the first, so as at one of their Ends to touch one another, and contain an Angle of about ten or fifteen Minutes, and the same be first moisten'd on their inward Sides with a clean Cloth, dipped into Oil of Oranges, or Spirit of Turpentine, and a Drop or two of the Oil or Spirit be let fall

upon the lower Glass at the other End; so soon as the upper Glass is laid down upon the lower, so as to touch it at one End as above, and to touch the Drop at the other End, making with the lower Glass an Angle of about ten or fifteen Minutes, the Drop will begin to move toward the Concourse of the Glasses, and will continue to move with an accelerated Motion till it arrives at that Concourse of the Glasses; for the two Glasses attract the Drop, and make it run that Way towards which the Attractions incline. And if, when the Drop is in Motion, you lift up that End of the Glasses where they meet, and towards which the Drop moves, the Drop will ascend between the Glasses, and therefore is attracted. And as you lift up the Glasses more and more, the Drop will ascend slower and slower, and at length rest, being then carried downward by its Weight, as much as upwards by the Attraction. And by this Means you may know the Force by which the Drop is attracted at all Distances from the Concourse of the Glasses.

16. There are therefore Agents in Nature able to make the Particles of Bodies stick together by very strong Attractions. And it is the Business of Experimental Philosophy to find them out.

GREAT BEAR. See *Ursa Major*.

GREAT CIRCULAR SAILING, is the Manner of conducting a Ship in, or rather pretty near the Arch of a great Circle, that passes through the Zenith of the

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two Places from whence, and to which she is bound.

GREAT CIRCLES of the *Globe* or *Sphere*, are those whose Plane passing through the Centre of the Sphere, divides it into two equal Parts or Hemispheres; of which there are six drawn on the *Globe*, viz. the Meridian, Horizon, Equator, Ecliptick, and the two Colures. Which see.

GREGORIAN YEAR. The new Account, or new Style, instituted upon the Reformation of the Kalendar, by Pope Gregory XIII. (from whom it takes the Name.) In the Year 1582, whereby ten Days being taken out of the Month of *October*, the Days of their Months go always ten Days before ours: As for Instance, their eleventh is our first Day. Which new Style, or Account, is used in most Parts beyond the Seas; and is called from Pope Gregory, the *Gregorian Account*.

GRENADO. See *Grenado-Shell*.

GROUND-PLATES, in Architecture, are the outermost Pieces of Timber lying on or near the Ground, and framed into one another with Mortesses, and Tennonns of the Joists, the Summer, and Girders; and sometimes the Trimmers for the Stair-Case and Chimney-Way, and the Binding-Joists.

GUERITE, in Fortification, is a small Tower of Wood or Stone, placed usually on the Point of a Bastion, or on the Angles of the Shoulder, to hold a Centinel, who is to take Care of the Ditch, and to watch out against a Surprise.

GULA, or GULLET. See *OEsophagus*.

GULBE, in Architecture, the same as *Gorge*.

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GULF, in Geography, is such a Part of the Ocean, as runs up into the Land, thro' narrow Passages, or Streights; as the Gulf of *Florida* in *America*; the *Arabian Gulf*, or *Red-Sea* in *Africa*; the *Persian Gulf* in *Asia*; the Gulf of *Venice*, or the *Adriatick Sea* in *Europe*.

GUNTERS-LINE, or the *Line of Numbers*, is the common Line of Numbers, invented by Mr. *Gunter*, a Professor of Geometry at *Gresham-College*. It is only the Logarithms laid off upon straight Lines; and its Use is for performing Operations of Arithmetick, by Means of a Pair of Compasses, or even without, by sliding two of these Lines of Numbers by each other.

GUNTERS-QUADRANT, is a Quadrant of Wood, Brass, &c. being partly a Stereographical Projection upon the Plane of the Equinoctial, the Eye being in one of the Poles, where the Tropick, Ecliptick, and Horizon, are Arches of Circles; but the Hour-Circles are all Curves drawn by Means of the several Altitudes of the Sun for some particular Latitude every Day in the Year. The Use of this Instrument, is to find the Hour of the Day, the Sun's Azimuths, &c. and the other common Problems of the Globe; as also to take the Altitude of an Object in Degrees: But these Quadrants, as commonly sold by Instrument-Makers, are of but very little Use, on Account of their Inaccuracy, and the small Radius they are made to. They may indeed serve Country-Fellows to tell what is a Clock to half an Hour, or a Quarter perhaps;

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as likewise to amuse their ignorant Neighbours.

Note, This Quadrant is by no Means so good as *Collins's*, in finding the Hour of the Day.

GUNTERS-SCALE, usually call'd by Seamen the *Gunter*, is a large plain Scale, with the Lines of artificial Sines, Tangents, and versed Sines, laid off upon straight Lines on it, so contrived to a Line of Numbers upon it, that by Means of this Scale, and a Pair of Compasses, all the Cases of plain and spherical Trigonometry may be solv'd tolerably exact, and consequently all Questions in Navigation, Dialling, &c. may be work'd by it.

The Name of this Scale is from the first Inventer, Mr. *Gunter*. It is now commonly put upon Sectors, being there call'd *Artificial Lines*.

GUTTE, or DROPS, in Architecture, are certain Parts in Figure of little Bells, which being six in Number, are placed below the Triglyphs, in the Architrave of the *Dorick* Order. These are thus named from their Shape, resembling the Drops of Water, that having run along the Triglyphs, still hang under the Closure between the Pillars.

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HALF-MOON, in Fortification, is an Out-Work having only two Faces, forming together a Salient-Angle, which is flank'd by some Part of the Place, and of the other Bastions.

HALF-MOONS are sometimes rais'd before the Courtrains, when the Ditch is a little wider than

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it should be; and they are much the same as Ravelins, only the Gorge of the Half-Moon is made bending in, like a Bow, and most commonly covers the Point of a Bastion; whereas Ravelins are placed before the Courtain; but they are defective, as being not well flank'd.

HALF-TANGENT. See *Scale*.

HALLO, or HALLOS, is a certain Meteor, in Figure of a bright Circle, encompassing the Sun, Moon, or a Star, especially the Moon.

These *Hallas's* do sometimes appear colour'd, like the Rainbow. And Sir *Isaac Newton*, in his *Opticks*, gives a Hint of their Solution; where he shews that they arise from the Sun, or Moon's shining through a thin Cloud, consisting of Globules of Hail or Water, all of the same Size.

HARMONICAL, or MUSICAL PROPORTION. Three or four Quantities are said to be in an Harmonical Proportion; when in the former Case, the Difference of the first and second shall be to the Difference of the second and third, as the first is to the third; and in the latter, the Difference of the first and second to the Difference of the third and fourth, as the first is to the fourth: For Example, 2, 3, and 6, are harmonically proportional: For 1, 3, 2, 6, if proportional Terms in the former Case are continu'd, there will arise an harmonical Progression.

If there be three Quantities in an harmonical Progression, the Difference between the second and twice the first, is to the first, as the second is to the third. Also the Sum of the first

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and last is to twice the first, as the last is to the middle one.

If there be four Quantities in an harmonical Proportion, the Difference between the second and twice the first, is to the first, as the third to the fourth.

HARMONY, is an agreeable or pleasant Union between two or more Sounds, continuing together at the same Time.

Consonances naturally produce Harmony; but Consonances and Dissonances artfully mix'd, produce the agreeablest Harmony.

HEAD-ANGLES. See *Angles*.

HEAT, in a *hot Body*, is the Agitation of the Parts of the Body, and the Fire contained in it; by which Agitation a Motion is produced in our Bodies, exciting the Idea of Heat in our Minds; and Heat, in respect of us, is only that Idea; and in the hot Body is nothing but Motion.

HEAT, in *all Bodies*, is a Motion that may be infinitely diminish'd, and there may be such a Motion, tho' it be not sensible to us, because often we cannot discover any Thing of Heat.

1. No Heat is sensible to us, unless the Body that acts upon our Organs of Sense has a greater Degree of Heat than that of our Organs.

2. The Heat of a Body is not in Proportion to the Quantity of Fire.

3. Several heated Bodies will become lucid, if their Heat be increased.

4. Heat may be so increased, that in some Bodies the Attracting Force is overcome by the Repelling Force; and in this Case the Particles fly from each other, and acquire an Elastic

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Force, such as the Particles of Air have.

5. The Equinoctial Heat of the Sun, when he becomes Vertical, is as twice the Square of the Radius.

6. Under the Equinoctial, the Heat of the Sun is as the Sine of the Sun's Declination.

7. In the *Frigid Zones*, when the Sun sets not, the Heat is as the Circumference of a Circle into the Sine of the Altitude: These Aggregates of Warmth are as the Sines of the Sun's Declination; and at the same Declination of the Sun, they are as the Sines of the Latitudes; and generally they are as the Sines of the Latitudes into the Sines of the Declination.

8. The Equinoctial Day's Heat is every where as the Co-Sine of the Latitude.

9. In all Places where the Sun sets, the Difference between the Summer and Winter-Heats, when the Declinations are contrary, is equal to a Circle into the Sine of the Altitude at Six, in the Summer-Parallel, and consequently those Differences are as the Sines of Latitude into, or multiplied by the Sines of Declination.

10. The Tropical Sun under the Equinoctial has of all others the least Force under the Pole: It is greater than any other Day's Heat whatsoever, being to that of the Equinoctial, as 5 to 4.

11. The Heat of the Sun for any small Portion of Time, is always as a Rectangle, contain'd under the Sine of the Angle of Incidence of the Ray, producing Heat at that Time.

12. From the following Table, and these Properties of the Sun's Heat, we may have a General Idea

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Idea of that Part of Heat that arise simply from the Presence of the Sun.

The Table shewing the Quantity of Heat to every 10th Degree of Latitude.

Lat.	Sun in V. ☊.	Sun in ☉.	Sun in ☋.
0	20000	18341	18341
11	19696	20290	15834
20	18797	21737	13166
30	17321	22651	10124
40	15321	23048	6944
50	12855	22991	3798
60	10000	22773	1075
70	6840	23543	000
80	3473	24675	000
90	0000	25055	000

But the different Degrees of Heat and Cold in differing Places, depend in a great Measure upon the Accidents of the Neighbourhood of high Mountains, whose Height exceedingly chills the Air brought by the Winds over them; and of the Nature of the Soil, which variously retains the Heat, particularly the Sands, which in *Africa*, *Arabia*, and generally where such sandy Desarts are found, do make the Heat of the Summer incredible to those that have not felt it.

HEGIRA, a Term in Chronology, signifying the *Epocha*, or Account of Time used by the *Arabians* and *Turks*, who begin their Computation from the Day that *Mahomet* was forced to make his Escape from the City of *Mecca*, which happen'd on *Friday July 16. A. D. 622.* under the Reign of the Emperor *Heraclens*.

HEIGHT of a Figure. See *Altitude of a Figure*.

HEIGHT of the Pole. See *Altitude of the Pole*.

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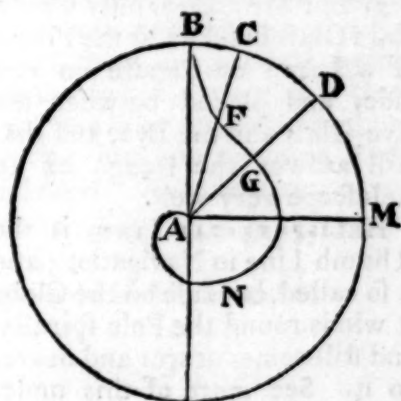
HELIACAL RISING, is when a Star, having been under the Sun-Beams, gets out so as to be seen again.

HELIACAL-SETTING of a Star, is when it, by the near Approach of the Sun, first becomes inconspicuous. This is reckon'd in the Moon, but at seventeen Degrees distance, or thereabouts; but in other Stars, 'tis as soon as they get distant, or come near the Sun by the Space of a whole Sign.

HELICE MAJOR and MINOR; the same with *Ursa Major* and *Minor*.

HELICOID PARABOLA, or the PARABOLICK SPIRAL, is a Curve which arises from the Supposition of the Axis of the common *Apollonia Parabola*; being bent round into the Periphery of a Circle, and is a Line then passing through the Extremities of the Ordinates, which do now converge towards the Centre of the said Circle.

1. Suppose the Axis of the common Parabola to be bent into the Periphery of the Circle *BDM*, then the Curve *BFGNA*, which passes through the Extre-



mities of the Ordinates *CF*, *DG*, which converge towards the Centre *A* of the Circle, is

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what is call'd the *Helicoid*, or *Spiral Parabola*.

2. If the Arch *BC*, as an Abscisse, be call'd x ; and the Part *CF* of the Radius, as an Ordinate to it be call'd y ; then the Nature of this Curve will be express'd by $1x = yy$; supposing 1 equal to the *Latus Rectum* of the Parabola.

HELICOSOPHY, is the Art of delineating all Sorts of Spiral Lines in Plano.

HELIOCENTRICK PLACE of a Planet, is that Point of the Ecliptick to which the Planet, seen from the Sun, is referred, and is the same as the Longitude of the Planet seen from the Sun.

HELIOSCOPES, are a Sort of Telescopes fitted so, as to look on the Body of the Sun without Offence to the Eyes.

1. Because the Sun may be seen through colour'd Glasses without Hurt to the Eye; therefore, if the Object and Eye-Glasses of a Telescope be made with colour'd Glass, as Red and Green, and equally colour'd and pellucid, that Telescope will become a Helioscope.

2. But Mr. *Hugens* only used a plain Glass blacked at the Flame of a Lamp or Candle on one Side, and placed between the Eye-Glass and the Eye, and that will answer the Design of an Helioscope very well.

HELISPHERICAL LINE, is the Rhumb Line in Navigation; and is so called, because on the Globe it winds round the Pole spirally, and still comes nearer and nearer to it. See more of this under *Rhumb-Line*.

HELIX, in Geometry, is the same as Spiral. Which see.

HEMISPHERE, is the Half of

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the Globe or Sphere, when 'tis supposed to be cut through the Centre in the Plane of one of its greatest Circles. Thus the Equator divides the Terrestrial Globe into the Northern and Southern Hemisphere; and the Equinoctial, the Heavens after the same Manner.

1. The Centre of Gravity of a Hemisphere, is five Eighths of the Radius distant from the Vertex.

2. The Horizon also divides the Earth into two Hemispheres, the one light, and the other dark, according as the Sun is above or below that Circle.

3. Also Maps or Prints of the Heavens, Constellations, &c. pasted on Boards, are sometimes called *Hemispheres*, but usually *Planispheres*.

4. The Writers of Opticks prove, That a Glass-Hemisphere unites the Parallel Rays at the Distance of a Diameter and one Third of a Diameter from the Pole of a Glass.

HEMITONE, in Musick, was what we now call an *Half-Note*.

HENDECAGON, in Geometry, is a Figure that hath eleven Sides, and as many Angles.

HENDECAGON, in Fortification, is taken for a Place defended by eleven Bastions.

HENIOCHUS, one of the Northern Constellations of fixed Stars. See *Auriga*.

HEPTAGERAL NUMBER. See *Polygenous Numbers*.

HEPTAGON, in Geometry, is a Figure of several Sides and Angles; and is called a *Regular Heptagon*, if those Sides and Angles be equal.

HEPTAGON,

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HEPTAGON, in Fortification, is taken for a Place that hath seven Bastions for its Defence.

HEPTANGULAR FIGURE, in Geometry, is that which consisteth of seven Angles.

HERISSON, in Fortification, is a Beam armed with a great Quantity of small Iron Spikes or Nails, having their Points outward, and is supported by a Pivot, upon which it turns, and serves instead of a Barrier to block up any Passage. They are frequently placed before the Gates, and more especially the Wicket-Doors of a Town or Fortrefs, to secure those Passages which must of Necessity be often opened and shut.

HERMETICAL SEALING, or **HERMES'S SEAL**, or to seal or stop up any Glass hermetically, is to heat the Neck of the Glass till it be just ready to melt, and then with a Pair of hot Pinchers to pinch or close it together.

HERMITAN, is the Name of a dry North and North-Easterly Wind, which usually blows on the Coasts of *Guinea* in *Africk*; but sometimes it blows also from other Points.

HERSE, in Fortification, is a Lettice, or Portcullice, made in the Form of a Harrow, and beset with many Iron Spikes. It is usually hung by a Cord fasten'd to a Moulinet, which is cut in Case of a Surprise; or when the first Gate is broken with a Petard, to the End that the Herse may fall, and stop up the Passage of the Gate, or other Entrance of a Fortrefs. These Hersees are also often laid in the Roads to incommode the March, as well of the Horse, as of the Infantry,

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HERSILLON, in Fortification, is a Plank stuck with Iron Spikes, for the same Use as the Herse.

HETERODROMUS VECTIS, or **LEAVER**, in Mechanicks, is that where the Hypomochlion is placed between the Power and the Weight; and where the Weight is elevated by the Descent of the Power and Contrariwise.

HETEROGENEAL NUMBERS, are mix'd Numbers, consisting of whole ones, (or Integers,) and of Fractions.

HETEROGENEAL SURDS, are such that have different Radical Signs; as $\sqrt[2]{aa}$, $\sqrt[5]{bb}$, $\sqrt[3]{9}$, $\sqrt[7]{18}$, &c.

If the Indexes of the Powers of the Heterogenous Surds be divided by their greatest common Divisor, and the Quotients be set under the Dividends; and those Indexes be multiplied crosswise by each other's Quotients; and before the Products be set, the common Radical Sign $\sqrt{}$, with its proper Index; and if the Powers of the Given Roots be involved alternately according to the Index of each other's Quotient, and the common Radical Sign be prefix'd before those Products, then will those two Surds be reduced to others, having but one common Radical Sign. As to reduce

$$\sqrt[2]{aa} \text{ and } \sqrt[4]{bb}.$$

$$2) \sqrt[2]{aa} \quad (2 \sqrt[4]{bb}.$$

$$\begin{array}{c} J \\ \times \\ 2 \end{array}$$

$$\sqrt[4]{bb}$$

$$\sqrt[4]{aaaa}.$$

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HETEROGENEAL LIGHT, by Sir *Isaac Newton*, is said to be that which consists of Rays of differing Degrees of Refrangibility: Thus, the common Light of the Sun or Clouds is heterogeneous, being a Mixture of all Sorts of Rays.

HETEROGENEOUS PARTICLES, are such as are of different Kinds, Natures, and Qualities, of which generally all Bodies consist of.

HETEROSCHII, in Geography, are such Inhabitants of the Earth as have their Shadows falling but one Way; as those who live between the Tropicks and Polar Circles, whose Shadows at Noon in North Latitude, are always to the Northward, and in South Latitude to the Southward.

HEXACHORD, a certain Interval of Musick or Concord, commonly called a *Sixth*; and is twofold, *viz.* the Greater and Lesser.

The greater Hexachord is composed of two greater Tones, two lesser Tones, and one greater Semi-Tone, which are five Intervals; but the lesser Hexachord consists only of two greater Tones, one lesser Tone, and two greater Semi-Tones.

The Proportion of the former, in Numbers, is as 3 to 5; and that of the latter, as 5 to 8.

HEXAGON, in Geometry, is a Figure of six Sides and Angles; and if those Sides and Angles be equal, 'tis called a *Regular Hexagon*.

The Side of every Regular Hexagon inscrib'd in a Circle, is equal in Length to the Radius of that Circle.

As 1 is to 1.672, so is the Square of the Side of any Regular Hexagon to the Area thereof.

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HEXAHEDRON, one of the *Platonick Bodies*, is the same as the Cube, being a Regular Solid of six equal Sides or Faces.

HEXASTYLE, an antient Building, which had six Columns in the Face before, and six also behind, and is the same with the *Pseudodipteron*.

HIP-ROOF, in Architecture, is such a Roof as hath neither Gable-Heads, Shred-Head, nor Jerkin-Heads. These Hip-Roofs, by some, are called *Italian Roofs*.

HIPPEUS, or *EQUINUS*, a Comet which some will needs have to resemble a Horse. But the Shape of this Kind of Comet is not always alike, as being sometimes Oval, and sometimes imitating a Rhomboides. Its Train, in like manner, is sometimes spread from the Front or Fore-Part; and at other Times from the Hinder-Part: Therefore they are distinguished into *Equinus Barbatus*, *Equinus Quadrangularis*, and *Equinus Ellipticus*.

HIPS, in Architecture, are those Pieces of Timber which are at the Corners of a Roof. They are a good deal longer than the Rafters, because of their oblique Position, for they are level at every Angle.

HIRCUS, a fixed Star, the same with *Capella*.

HIRCUS, a Name given by some to a Sort of a Comet encompassed by a kind of Mane, seeming to be rough and hairy, by reason of its Rays appearing like Hair. It is also sometimes without any Train or Bush.

HOBITS, are a Sort of small Mortars from six to eight Inches Diameter: Their Carriages are like those of Guns, only much shorter.

shorter. They are very good for annoying the Enemy at a Distance with small Bombs, which they will throw two or three Miles; or in keeping of a Pass, being loaded with Cartouches.

HOLLOW-TOWER, in Fortification, is a Rounding made of the Remainder of two Brizures, to join the Curtain to the Orillon, where the small Shot are play'd, that they may not be so much exposed to the View of the Enemy.

HOMOCESTRICK. The same with *Concentrick*.

HOMODROMUS VECTIS, or **LEVER**, is one where the Weight is in the Middle between the Power and the Fulcrum, or the Power in the Middle between the Weight and the Fulcrum.

HOMOGENEAL, signifies of the same Kind or Sort, or that which differs not in Nature, &c. The same with *Homogeneous*.

HOMOGENEAL NUMBERS, are those of the same Nature and Kind.

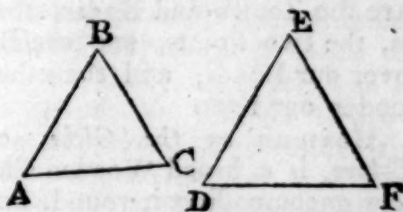
HOMOGENEAL SURDS, are such as have one common Radical Sign; as $\sqrt[2]{a}$, $\sqrt[2]{b}$, or $\sqrt[3]{b}$; or $\sqrt[3]{c^6}$, $\sqrt[3]{c^9}$.

HOMOGENEOUS PARTICLES, are such as are all of the same Kind, Nature, and Properties; as the Parts of pure Water, of meer Earth without Salt in it, or the Parts of the finer Metals; such as Gold, Silver, &c. 'Tis used in Opposition to heterogeneous. Which see.

HOMOGENEAL LIGHT, is that whose Rays are all of one Colour, and Degree of Refrangibility, without any Mixture of others. See *Colours*.

HOMOGENEUM COMPARATIONIS, by *Vieta*, is the absolute Number in a Quadratick, or Cubick, &c. Equation; and this Number always possesseth one Side of the Equation, and is the Product of the Roots multiplied into one another.

HOMOLOGOUS SIDES or ANGLES of two Figures, are those that keep the same Order from the Beginning in each Figure; as in the two similar Triangles



ABC, DEF; the Sides *AC, DF*; *AB, DE*; *BC, EF*; as also the Angles *A, D*; *B, E*; *C, F*, are Homologous.

HOOP-WHEEL. See *Detent-Wheel*.

HORIZON, is that great Circle which divides the Heavens and the Earth into two Parts, or Hemispheres, distinguishing the Upper from the Lower. It is either Sensible or Apparent, or the Rational or True Horizon.

1. The Sensible or True Horizon is that Circle which limits our Light, and may be conceived to be made by some great Plane, or the Surface of the Sea.

2. It divides the Heavens and Earth into two Parts; the one light, and the other dark; which are sometimes greater or lesser, according to the Condition of the Place, &c.

3. It determines the Rising and Setting of the Sun, Moon, or

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or Stars in any particular Latitude; for when any of these appear just at the Eastern Part of the Horizon, we say it rises; and when it doth so at the Western Part, we say it sets. And from hence also the Altitude of the Sun or Stars is accounted, which is their Height above the Horizon.

HORIZON *Rational, Real, or True*, is a Circle which encompasses the Earth exactly in the Middle, and whose Poles are the Zenith and Nadir, that is, the two Points, one exactly over our Heads, and the other under our Feet.

HORIZON *on the Globe, or Sphere*, is a broad Wooden Circle encompassing it round, and representing the Rational Horizon, having two Notches on the North and South Parts of it for the Brazen Meridian to stand in. On this broad Wooden Horizon several Circles are drawn, the innermost of which is the Number of Degrees of the twelve Signs of the Zodiack, viz. thirty Degrees to each Sign.

Next to this you have the Names of those Signs; then the Days of the Month, according to the *Julian Account*, or Old Style, with the Kalendar according to the Foreign Account, called *New Style*; and without these is a Circle divided into thirty two equal Parts, which make thirty two Rhumbs, or Points of the Mariner's Compass, with the first Letters of their Names annexed.

The Uses of this Circle on the Globe are,

1. To determine the Rising and Setting of the Sun, Moon, or

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Stars; and to shew the Time of it by the Hour-Circles and the Index.

2. To limit the Increase and Decrease of Day and Night: For when the Sun rises due East, and sets West, the Days and Nights are equal; but when he rises and sets to the North of the East and West, the Days are longer than the Nights; but the Nights are longer than the Days, when the Sun rises and sets to the Southward of the East and West Points of the Horizon.

3. To shew the Amplitude and Point of the Compass the Sun rises and sets upon.

HORIZONTAL LINE, or BASE of a Hill, is the Line *AB* drawn



upon a Plane parallel to the Horizon whereon the Hill is supposed to stand.

HORIZONTAL DIAL, is one whose Plane is parallel to the Horizon of any Place.

In all Horizontal Dials the Style makes an Angle equal to the Latitude of the Place, and the Angles that the Hour-Lines make with the Meridian, may be found by this Proportion: As the Radius is to the Sine of the Latitude, so is the Tangent of any Hour's Distance from 12 to the Tangent of the Angle that the Hour-Line of that Hour makes

makes with the Hour-Line of 12.

HORIZONTAL LINE, is any Line drawn parallel to the Horizon upon a Plane.

HORIZONTAL LINE of a Dial, is a Line drawn through the Foot of the Style parallel to the Horizon.

HORIZONTAL PARALLAX. See *Parallax*.

HORIZONTAL PROJECTION. See *Projection*.

HORIZONTAL RANGE, or **LEVEL RANGE of a Piece of Ordnance**, is the Line that a Ball describes parallel to the Horizon or Horizontal Line when the Piece is level.

1. The Horizontal Ranges are the shortest. And some Pieces of Cannon will make them six hundred Passes, and some but a hundred and fifty; and the Ball, with the Range of six hundred Passes, will go from nine to thirteen Foot into the Earth.

HORN-WORK, in Fortification, is an Out-Work, which advanceth toward the Field, carrying in the Forepart, or its Head, two Demi-Bastions, in Form of Horns. These Horns, Epaulments, or Should'rings, being joined by a Curtain, shut up on this Side by two Wings, parallel one to another, are terminated at the Gorge of the Work, and so present themselves to the Enemy.

HOROLOGIOGRAPHY, is the Art of making Dials, Clocks, or other Instruments to shew the Time of the Day.

HOROMETRY, is the Art of measuring or dividing the Hours, and keeping Account of Time.

HOROETER, in Opticks, is a Right Line drawn through the Point of Concurrence, parallel to that which joins the Centre of the Eye.

HOROSCOPE, in Astrology, signifies the first House, or Ascendant, and is that Part of the Zodiack which is rising at the Time of the Calculation of a Scheme.

HORSE-SHOE, in Fortification, is a Work of a round, and sometimes oval Figure, raised in the Ditch of a marshy Place, or in low Ground, and bordered with a Parapet. It is made to secure a Gate, or to serve as a Lodgment for Soldiers to prevent Surprizes, or to relieve an over-tedious Defence.

HOURL, is the twenty-fourth Part of a Natural Day, containing sixty Minutes, and each Minute sixty Seconds, &c. These are Astronomical Hours, which always begin at the Meridian, and are reckon'd from Noon to Noon.

1. But some Hours are begun to be accounted from the Horizon; which, when the Account begins at the Sun's Rising, are called *Babylonish Hours*, which begin with the Sun's Rising, and reckon on twenty four Hours to his Rising again the next Day.

2. Others are reckon'd after the same Manner, only they begin at the Sun's Setting instead of its Rising; and these are called *Italian Hours*, because the *Italians* account their Time after this Fashion.

3. There is yet another Kind of Hours, which are called *Jewish Hours*; because of old the
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Jews accounted their Time this Way. They are one twelfth Part of the Day or Night, reckoned from the Sun Rising to the Sun Setting, (if the Days or Nights be long or short;) and these were called, as we find in the holy Scripture, the *First*, *Second*, and *Third*, &c. *Hours of the Day or Night*.

Hour-Circles, the same with Meridians, are great Circles, meeting in the Poles of the World, and crossing the Equinoctial at Right Angles. They are to be drawn through every fifteenth Degree of the Equinoctial and Equator, and on both Globes are supplied by the Meridian, Hour-Circle, and Index.

The Planes of the Hour-Circles are pendicular to the Plane of the Equinoctial, which they divide into twenty four Parts.

Hour-Lines on a Plane Dial, are the Intersections of the Plane of the Dial, with the Planes of the Hour-Circles of the Sphere.

Hour-Scale, is a divided Line on the Edge of *Collin's* Quadrant, being only two Lines of Tangents of forty five Degrees each, set together in the Middle; and the Use of it, together with the Lines of Latitudes, is to draw the Hour-Lines of Dials that have Centres, by Means of an Equilateral Triangle, drawn on the Dials.

Hurdles, or Clays, in Fortification, are made of thick and small Twigs of Willow, or Osiers, being five or six Foot high, and from three to four Foot broad. They are interwoven very close together, and

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usually laden with Earth, that they may serve to render Batteries firm, or to consolidate the Passage over muddy Ditches, or to cover Traverses and Lodgements for the Defence of the Workmen against the artificial Fires or Stones that may be cast upon them.

HYALOIDES, is the Vitreous Humour of the Eye contain'd betwixt the Tunica - Retina and the Uvea.

HYBERNAL OCCIDENT. See *Occident*.

HYBERNAL ORIENT. See *Orient*.

HYDATOIDES, is the Watery Humour of the Eye contained betwixt the Tunica-Retina and the Uvea.

HYDRA, a Southern Constellation, consisting of twenty six Stars, and imagined to represent a Water-Serpent.

HYDRAULICKS, is the Science of the Motion of Fluids, especially Water, under which is contain'd the Structure of all Fountains, Engines to carry or raise Water, or which are mov'd by Water, and some for other Uses.

HYDRAULICO-PNEUMATICAL ENGINES, are those that raise Water by Means of the Spring, or natural Force of the Air.

HYDROGRAPHICAL CHARTS, are certain Sea-Maps, delineated for the Use of Pilots and other Mariners; wherein are marked all the Rhumbs or Points of the Compass, and Meridians parallel to one another, with Shelves, Shallows, Rocks, Capes, &c.

HYDROGRAPHY, is an Art which teacheth how to describe and measure the Sea; giving an

an Account of its Tides, Counter-Tides, Soundings, Bays, Creeks, &c. as also Rocks, Shelves, Sands, Shallows, Promontories, Harbours, Distance from one Part to another, and other Things remarkable on the Coasts.

HYDROSTATICKS, is the Science of the Gravitation of Fluids, and of their Action, when demersed in Solids.

This is a Part of Philosophy which ought to be looked upon as the most ingenious of any, the Theorems and Problems of this Art being handsome Productions of Reason, and affording Discoveries not only pleasing, but also surprisngly wonderful and useful.

HYDROSTATICAL BALLANCE. See *Ballance*.

HYEMAL SOLSTICE. See *Solstice*.

HYGROMETER, is a Philosophical Instrument, which measures the Dryness and Moisture of the Air.

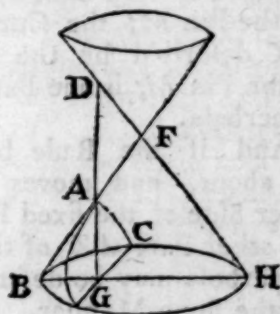
HYGROSCOPE, is an Instrument shewing the Increase and Decrease of the Dryness of the Air.

The Hygroscope of Mr. *Molynux*, being a very simple and good one, is made thus :

Fasten a Piece of Whipcord, of about four Foot long, to a Hook or Staple, in some convenient Place of the Ceiling of a Room, and at the Bottom hang a Weight of about a Pound; let thereon, or into the Bottom of the Weight, be fastened an Index of about a Foot long, and under it, on a Table, or on a Piece of Board, place a Circle, divided into what Number of Degrees you please, and fit it so that the Centre of the In-

dex may hang just over the Centre of the Circle. After it has hung thus two or three Days, to stretch the Cord, you may begin to measure by it the Degrees of Moisture or Drought in the Air; for the Cord will twist one Way, and contract itself for wet, and untwist itself again on the contrary Way for dry.

HYPERBOLA, is a Curve made by cutting a Cone by a Plane that falls within the Circular Base of the Cone, but not parallel to the Side of the Cone, nor cuts it thro' the Vertex, and which Plane, if continu'd, will cut the opposite Cone; as the Curve *CAC* is an Hyperbola,

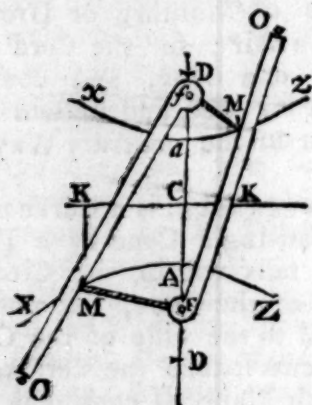


if the Plane *AG*, continu'd out, cuts the opposite Hyperbola in *D*, and is not parallel to the Side *FH*, nor does pass through the Vertex *E*.

1. If one End of a long Rule *fMO* be fastened in the Point *f*, taken on a Plane, in such a Manner, that it may turn freely about that fixed Point *f*, as a Centre; and one End of the Thread *fMO* (being in Length less than the said Rule) be fixed to *O*, the other End of the Rule, and the other End of the Thread be fixed in the Point *F*, taken on the Plane; then if the

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the Rule fMO be turned about the fixed Point f ; and at the same Time you keep the Thread OMF always in an equal Ten-



sion, and its Part MO close to the Side of the Rule, by Means of the Pin M ; the Curve Line AX describ'd by the Motion of the Pin M , is one Part of an Hyperbola.

And if the Rule be turned about, and moves on the other Side of the fixed Point F , the other Part AZ of the same Hyperbola may be describ'd after the same Manner.

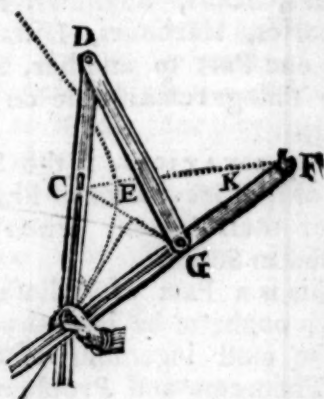
But if the End of the Rule be fastened in F , and that of the Thread in f , (the Rule and Thread keeping the same Lengths,) you may describe another Curve Line zax after the same Manner, which will be opposite to XAZ , and is likewise an Hyperbola.

2. If there be given the two Foci C, F , of an Hyperbola, and the Vertex E , and it is requir'd to describe an Hyperbola to these Foci and Vertex.

Let $KF=CE$, so that EK be the transverse Axis, and take three Rules CD, DG , and GF , so that $CD=GF=EK$, and $DG=$

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CE . Let the Rules CD, GF , be of an indefinite Length beyond



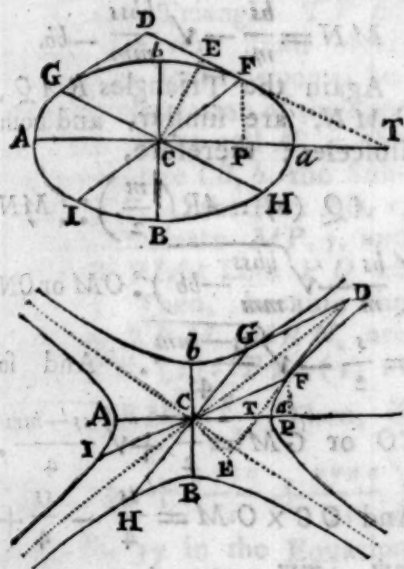
C, D , and have Slits in them the Breadth of the Pin that is to describe the Hyperbola. Moreover, let these Rules have Holes made in them at C, E , in order to fasten them to the Foci C and F , by Means of Points, and at the Places D, G , they are to be joined by the Rule DG . This being done, if a Pin be put in the Slits, viz. the common Intersection of the Rules CD, GF , and mov'd along, causing the two Rules GF, CD , to turn about the Foci C, F , that Pin will describe the Portion Ee of an Hyperbola.

3. Any Parallelogram describ'd about an Ellipsis, or between the Conjugate Hyperbola's, so that the four Points of Contact may be joined by two Diameters GH, IF only, which therefore will be Conjugates, is equal to the Parallelogram describ'd about the two Axes Aa, Bb ; and consequently all such Parallelograms are equal to one another.

3. From F , the Extremity of one Diameter, draw the Line FD parallel to the other Diameter GH , (continued out in the

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the opposite Hyperbola's,) meeting the Axis (produced in the Ellipsis) in the Point T , and from G the Extremity of the Diameter GH draw the Line GD parallel to the Diameter



IF , meeting DF in D : And from the Point F let fall the Perpendicular FP to the Axis Aa ; then GD , DE , will touch the Ellipsis, and the Hyperbola's bG , aF in G , F the Extremities of the Conjugate Diameters; and so the Parallelogram $CGDF$ will be one Fourth of that described about the Ellipsis, or between the Conjugate Hyperbola's, having the Condition mentioned in the Theorem: Therefore, if CE be drawn perpendicular to DE , (produced in the Conjugate Hyperbola's,) we are to prove that $CG (=DF) \times CE$ is $= Cb \times Ca = \frac{1}{4}$ of the Rectangle under the two Axes.

4. Call Ga , t , Cb , c , and Cp , x , then $\overline{Ca}^2 (tt) : AP \times Pa (tt - xx \text{ in Ellipsis, or } xx - tt \text{ in Hyperbola}) :: Cb (cc) : \overline{FP}^2$

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$= cc - \frac{ccxx}{tt}$. In the Ellipsis, or

$\frac{ccxx}{tt} - cc$ in Hyp. And $\overline{CF}^2 =$

$xx + cc - \frac{ccxx}{tt}$ in Ellip. or $xx -$

$cc + \frac{ccxx}{tt}$ in Hyp. because FPC is

a right-angled Triangle. Again,

$CP (x) : (a (t)) :: Ca (t) : CT =$

$\frac{tt}{xx}$. And $\overline{PT}^2 = xx - 2tt +$

$\frac{t^4}{xx}$, and $\overline{FT}^2 = xx + cc - 2tt +$

$\frac{t^4}{xx} - \frac{ccxx}{tt}$ in Ellip. or $xx - cc - 2$

$tt + \frac{t^4}{xx} + \frac{ccxx}{tt}$ in Hyp. because

FPT is a right-angled Triangle. Now, the Triangles FPT , CEP ,

are similar, because the Angles at E and P are right ones, and the

Angle ETC in the Ellip. common, (but in the Hyperbola the

Angle $ETC = PTF$,) whence

$\overline{FT}^2 \left(xx + cc - 2tt + \frac{t^4}{xx} - \frac{ccxx}{tt} \right) :$

$\overline{FP}^2 \left(cc - \frac{ccxx}{tt} \text{ or } \frac{ccxx}{tt} - cc \right) ::$

$\overline{CT}^2 \left(\frac{t^4}{xx} \right) : \overline{CE}^2 = \frac{t^4 c^2}{t^4 - t^2 x^2 + c^2 x^2}$.

Farther the Square of the Semi-Conjugate, viz. $\overline{CG}^2 (= \overline{Ca}^2 +$

$\overline{Cb}^2 - \overline{CF}^2$ in Ellip. or $= \overline{CF}^2 +$

$\overline{Cb}^2 - \overline{Ca}^2$ in Hyp.) is $= tt - xx$

$+ \frac{ccxx}{tt}$ in Ellip. or $xx + \frac{ccxx}{tt} -$

tt in Hyp. and $\overline{CE}^2 \times \overline{DF}^2 (= \overline{OG}^2) \overline{CG}^2$

is $= \frac{t^8 c^2 + t^4 c^4 x^2 + t^6 c^2 x^2}{t^6 + t^2 x^2 c^2 + t^4 x^4}$,

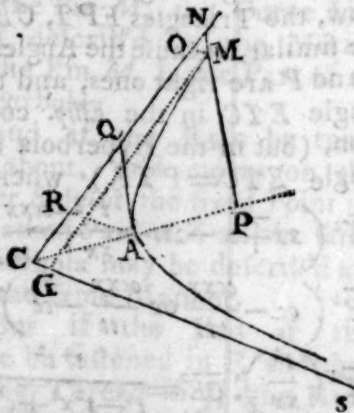
which is $= \overline{Ca}^2 \times \overline{Cb}^2 = \frac{1}{4} ttc$; as it evidently appears by multiplying the Denominator by $\frac{1}{4} ttc$;

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tec: And therefore $Ca \times Cb = CG \times CE$, and so $4CE \times EG = 4Cb \times Ca$. W.W.D.

5. If from any Point M in an Hyperbola there be drawn the Right Line MG parallel to the Asymptote CN, and the Right Line OM parallel to the other Asymptote CS. I say the Rectangle under OM \times OC will always be equal to the Square of the Line RQ, which is drawn from the Point A, wherein the Axis CP cuts the Curve, parallel to the Asymptote CS, and terminating in the other Asymptote CN.

For draw the Ordinate MP, and raise the Perpendicular AQ; now CR, RQ, RA, are equal to one another, because the Axis CP does bisect



the Angle form'd by the Asymptotes, and AQ perpendicular to the Axis, and AR parallel to CS: Then call CN, s , CQ, m , the Semi-Axis CA, a ; and the Line AQ, (which is equal to the Semi-conjugate Axis) b . The Triangles CAQ, CPN, are similar: Therefore CQ (m):

$$CN(s) :: CA(a) : CP = \frac{as}{m}.$$

$$\text{And } CQ(m) : CN(s) :: QA(b) :$$

$$NP = \frac{bs}{m}. \text{ But by the Nature}$$

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of the Hyperbola $\overline{CA}^2 (aa) : \overline{AQ}^2 (bb) :: CP + CA \times AP$

$$\left(\frac{aass}{mm} - aa \right) : \overline{PM}^2 = \frac{bbss}{mm} - bb.$$

Whence,

$$MN = \frac{bs}{m} - \sqrt{\frac{bbss}{mm} - bb}.$$

Again the Triangles RAQ, OMN, are similar, and both Isosceles; therefore,

$$AQ(b) : AR\left(\frac{m}{2}\right) :: MN$$

$$\left(\frac{bs}{m} - \sqrt{\frac{bbss}{mm} - bb} \right) : OM \text{ or } ON$$

$$= \frac{s}{2} - \sqrt{\frac{ss-mm}{4}}. \text{ And so}$$

$$CO \text{ or } GM = \frac{s}{2} + \sqrt{\frac{ss-mm}{4}}.$$

$$\text{And } OC \times OM = \frac{ss}{4} - \frac{ss}{4} +$$

$$\frac{mm}{4} = \frac{mm}{4}, \text{ which is equal to}$$

$$\overline{RA}^2 \text{ or } \frac{CQ^2}{4} \text{ W.W.D.}$$

The Demonstration of this Property's being easy and new, (at least to me,) was the Cause of my laying it down here.

6. If Aa be any Diameter of an Ellipsis, or Hyperbola, C the Centre, and if the Right Line TM touches this Ellipsis in the Point M, and the Ordinate MP be



be drawn from the Point of Contact to the Diameter Aa I say CP,

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CP, CA, CT are in continual
Proportion.

Suppose the Arch MN to be infinitely small, and draw NQ parallel to PM and MR , parallel to Aa ; now the small Triangle MNR will be similar to the Triangle TPM , because the very small Arch MN may be looked upon as being the Prolongation of the Tangent TM . Now call AC , a , the Semi-Conjugate CB , b , the Subtangent TP , s , the Part AP , x , the Semi-Ordinate MP , y , and the small Right Line $PQ = MR$, e : Then, because the Triangles TPM , MNR , are similar TP (s): PM (y) ::

$$MR(e): RN = \frac{e \cdot y}{s}. \quad \text{Then, if}$$

$$\overline{\mathcal{Q}N^2} \left(yy + \frac{2yye}{s} + \frac{yyee}{ss} \right)$$

be put for yy in the Equation

$$yy = \frac{2abbx - bbxx}{aa} \text{ expressing}$$

the Nature of the Ellipsis; and

$AQ(x+e)$ for x , we shall have $xy + \frac{2y^2}{x} + \frac{y^3}{x^2} =$

$$2abbx + 2abbe - bbbx - 2bbex - bbee,$$

aa

and if the former Equation
be subtracted from this then

will $\frac{2yye}{\quad} + \frac{yyee}{\quad} = \frac{\quad}{\quad}$

$2abb e - 2bbex - bbee$ and

dividing by a and afterwards

dividing by e , and afterwards striking out all the Terms ad-

fects with e , because they

are infinitely less than the others,

and then will $\frac{2yy}{s} = \frac{2abb - 2bbx}{aa}$

$$r \left(\frac{yy}{s} = \frac{abb - bbx}{aa} \right) \text{ and}$$

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again substituting for yy , its Va-

lue $\frac{2abbx - bbxx}{aa}$, and bb

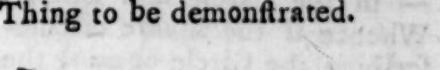
will be gotten out, and then s

will be $= \frac{2ax - x^2}{a - x}$. Now, πC

$$\times PC, \left(\frac{2ax - x^2}{a - x} + a - x \right)$$

$\times \frac{a}{a-x}$ that is, $\frac{a}{a-x} \times a - x$)

is \overline{AC}^2 (a a) which was the



11

After the same Manner we
prove this in the *Hyperbola* only

prove this in the Hyperbola, only observing here that the Equation expressing the Nature of the

name, is $yy = \frac{2abbx + bbxx}{\dots}$

7. If QFA be a Sector, con-

ain'd under two Right Lines,
meeting in the Centre Q , and



E

F

2

the Conick Curve $E A$, the Point

being the Extremity of the Axis: And if a Tangent in E

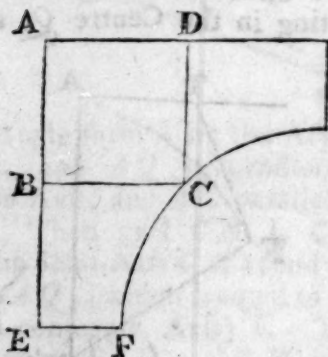
meets the Tangent in A in the
N^o 2 Point.

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Point T , and AT be call'd t ; and the Rectangle under half the *Latus Rectum*, and half the *Latus Transversum*, be supposed $= 1$, then shall the Sector of the *Hyperbola*, Circle or *Ellipsis*, divided by the *Semi-Latus Transversum* be $= \frac{t}{1} \pm \frac{t^3}{3} \pm \frac{t^5}{5} \pm \frac{t^7}{7}$, &c. The ambiguous Sign \pm being $+$ in the *Hyperbola*, and $-$ in the Circle and *Ellipsis*. Whence if the Square circumscribing the Circle be $= 1$, the following Series will be had, viz.

$$\frac{1}{3} + \frac{1}{8} + \frac{1}{15} + \frac{1}{24} + \frac{1}{35} + \frac{1}{48} + \frac{1}{63} + \frac{1}{80} + \frac{1}{99} + \frac{1}{120}, \text{ \&c.}$$

12. In these Series $\frac{1}{3} + \frac{1}{35} + \frac{1}{99}$, &c. expresses the Area of the Circle $ABCD$, and $\frac{1}{8} + \frac{1}{48} + \frac{1}{120}$, &c. The Area of the Equilateral *Hyperbola*

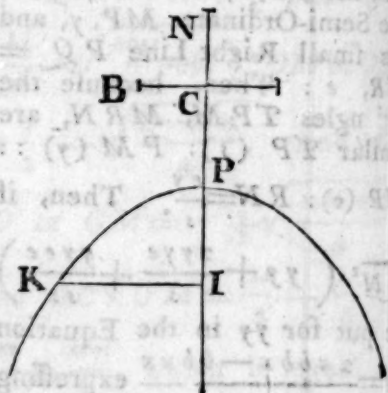


$BCEF$, when BC is the double of EF , and the inscrib'd Square be $= \frac{1}{4}$. The Num-

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bers 3, 8, 15, 24, being square ones lessen'd by Unity.

8. All the Properties of Diameters, Tangents, and Foci, &c. in the *Hyperbola*, are the same as those in the *Ellipsis*, only using Differences for Sums. As for Example, as the Square of the Semi-Conjugate, or second Axis BC , is to the Square of the Ordinate KI , so is the Square of the principal Axis NP , to the



Rectangle under NI and PI . Again, the Difference of the two Lines drawn from the Foci to the Curve, is always equal to the principal Axis. Also the Difference of the Squares of any two Conjugate Diameters are always equal to the Difference of the Squares of the Conjugate Axis.

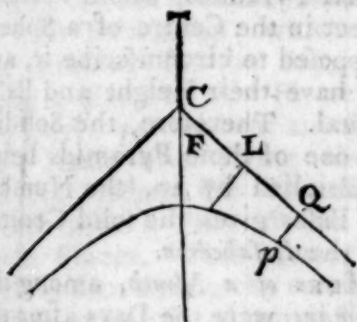
9. Any two Lines drawn in the *Hyperbola*, parallel to each other, and cut by a third, have the same Property as is mention'd of two Parallel Lines drawn in the *Ellipsis*. See *Ellipsis*.

HYPERBOLICAL CYLINDROID, is a solid Figure, whose Generation is given by Sir Christopher Wren, in *Philos. Transact.* N^o 48. There

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There are two opposite *Hyperbole*, joined by the Axis *Transversus*, and thro' the Centre there is a Right Line drawn at Right Angles to that Axis, the *Hyperbole* are supposed to revolve; by which Revolution a Body will be generated, which he calls an *Hyperbolick Cyliindroid*: And whose Bases, and all Sections parallel to them, will be Circles. And in N^o 53. of the *Transactions*, he applies it to the Grinding of Hyperbolical Glasses; and he says, they must be either formed this Way, or not at all.

HYPERBOLICK SPACE, is the Area or Space contained between the Curve of the Hyperbola and the whole Ordinate. If $CL = b$, and $LQ = x$, and



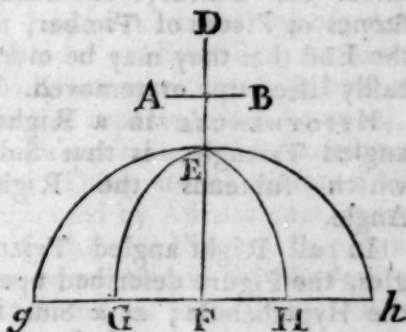
$CF = a$, and $QP = x$, then $a^2 = by + xy$; and if $a = b = 1$, then the Space between the Asymptotes will be expressed by

$$x - \frac{1}{2}x^2 + \frac{1}{3}x^3 - \frac{1}{4}x^4 + \frac{1}{5}x^5, \text{ \&c.}$$

Any *Hyperbolick Space* $GEHG$, is to any other *Hyperbolick Figure* of the same Height $gEb g$, (whose *Latus Rectum* and *Transversum*, as in the Circle, are equal; and also both equal to DE , the *Latus Transversum* of the former Space) :: as the Conju-

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gate Axis AB : is to the *Latus Transversum* DE .



HYPERBOLICUM ACUTUM, is a Solid made by the Revolution of the infinite Area of the Space contained between the Curve and the Asymptote, in the *Apolonian Hyperbola*, turning round that Asymptote. This produces a Solid or Body infinitely long; and yet, as *Torricellius* plainly demonstrates, (who gave it this Name,) it is equal to a finite Solid or Body.

HYPERBOLOIDES, or HYPERBOLIFORM FIGURES, are *Hyperbola's* of the higher Kind, whose Nature is expressed by this Equation $ay^{m+n} = \frac{bx^n}{a+x^n}$; and if m be greater than n , the *Hyperboliform Space* is squarable; but otherwise not.

HYPERTHYRON, in Architecture, is a large Table, usually placed over Gates or Doors of the *Dorick Order*, above the *Chambranle*, in form of a Frize.

HYPETHRE, in ancient Architecture, was two Ranks of Pillars all about, and ten at each Face of any Temple, &c. with a Peristile within of six Columns.

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HYPOMOCHLION, **FULCRUM**, or **PROP**, in Mechanicks, signifies the Roller, which is usually set under the Leaver, or under Stones or Pieces of Timber, to the End that they may be more easily lifted up, or removed.

HYPOTHENUSE in a Right-angled Triangle, is that Side which subtends the Right Angle.

In all Right-angled Triangles, the Figure described upon the Hypothennse; as a Side is equal to the Sum of the two Figures described upon the other two Sides of that Triangle, being all three similar.

HYPOTHESIS, is the same with Supposition; or it is a Supposition of that which is not, for that which may be; and it matters not whether what is supposed to be true, be so or not; but it must be possible, and should always be probable.

HYPOTRACHELION, in Architecture, is the Top or Neck of a Pillar, or the most slender Part of it, which toucheth the Capitol. It is taken by some for that Part of the *Tuscan* and *Dorick* Capitols, which lies between the *Echinus* and the *Astragal*; and is otherwise call'd the *Collar*, *Gorge*, or *Frize of the Chapter*.

I.

JACOB'S-STAFF, a Mathematical Instrument for taking Heights and Distances. The same with *Cross-Staff*.

ICHTHOGRAPHY, in Perspective, is the View of any Thing cut off by a Plane parallel to the Hori-

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zon, just at the Base or Bottom of it. And in Architecture, is taken for the Geometrical Plane or Platform of an Edifice, or the Ground-Plot of a House or Building delineated upon Paper, describing the Form of the several Apartments, Rooms, Windows, Chimneys, &c. and this is properly the Work of the Master-Architect or Surveyor, being indeed the most abstruse and difficult of any.

ICHTHOGRAPHY, in Fortification, is, in like Manner, the Plane or Representation of the Length and Breadth of a Fortress; the distinct Parts of which are marked either upon the Ground itself, or upon Paper.

ICOSAHEDRON, is a regular Body, consisting of twenty Triangular Pyramids, whose Vertexes meet in the Centre of a Sphere supposed to circumscribe it, and so have their Height and Bases equal. Therefore, the Solidity of one of those Pyramids being multiplied by 20, the Number of Bases gives the solid Content of the *Icosahedron*.

IDES of a Month, among the Romans, were the Days after the Nones were out. They commonly fell out on the 13th of every Month, except in *March*, *May*, *July*, and *October*, (which they called the *Full Months*, as all the others were called *Hollow*,) for then they were on the 15th, because in those Months the Nones were on the 7th.

JET D'EAU, is the French Word for a Pipe of a Fountain, which casts up the Water into the Air.

Mr. *Mariotte*, in his *Treatise Du Mouvement des Eaux*, &c. saith, That a *Jet d'Eau* will never

ver rise so high as its Reservatory, but always falls short of it by a Space, which is in a subduplicate Ratio of that Height; and this he proves by several Experiments.

He saith also, That if a greater branches out in smaller ones, distributed to different Jets, the Square of the Diameter of the main Pipe must be proportioned to the Sum of all the Expences of its Branches. And particularly he saith, That if the Reservatory be 52 Foot high, and the Adjutage half an Inch in Diameter, the Pipe ought to be three Inches in Diameter.

IGNIS-FATUUS, is a certain Meteor that appears chiefly in the Summer Nights, for the most part frequenting Church-Yards, Meadows, and Bogs, as consisting of a somewhat viscous Substance, or a fat Exhalation; which being kindled in the Air, reflects a Kind of thin Flame in the Dark, yet without any sensible Heat, often flying about Rivers, Hedges, &c. because it meets with a Flux of Air in those Places. This Meteor is well known among the common People under the Name of *Will-of-the-Whisp*, or *Jack-with-a-Lan-thorn*.

ILLUMINATIVE MONTH, is that Space of the Time that the Moon is visible, betwixt one Conjunction and another.

IMAGE, in Opticks, is the Appearance of an Object, by Reflexion or Refraction.

In all Plane-Speculums the Image appears of the same Magnitude as the Object, and as far behind the Speculum, as the Object is distant before it.

In Convex-Speculums, the

Image is farther distant from the Centre of the Convexity, than from the Point of Reflexion, and the Image appears less than the Object.

IMMENSE, is that whose Amplitude or Extension no finite Measure whatsoever, or how oft soever repeated, can be equal.

IMMERSION, is the plunging of any Thing under Water. 'Tis also used by Astronomers, to signify that any Planet is beginning to come within the Shadow of another; as in Eclipses, whenever the Shadow of the eclipsed Body begins to fall on the Body eclipsed, we say, that is the Time of Immersion; and when it goes out of the Shadow, is the Time of Emerfion.

IMPENETRABILITY, is the Distinction of one extended Substance from another, by which the Extension of one Thing is different from that of another; so that two Things extended, cannot be in the same Place, but must of Necessity exclude each other.

IMPERFECT CONCORD. See *Concords*.

IMPERFECT NUMBERS, are such whose aliquot Parts taken altogether, do either exceed, or fall short of that whole Number of which they are Parts; and these are two Sorts, either Abundant or Deficient. Which see.

IMPERIAL-TABLE, is an Instrument made of Brass, with a Box and Needle, and Staff, used to measure Land.

IMPERVIOUS. Bodies are said to be impervious to others, when they will neither admit the Rays of Light, &c. nor the Effluvia of other Bodies do pass thro' them.

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IMPOST, in Architecture, is a Plinth, or Little Cornice, that crowns a Piedroit or Peer, and supports the Couffinet, which is the first Stone that a Vault or Arch commences.

IMPROPER FRACTIONS, are such as have their Numerators equal to, or greater than their Denominators, as $\frac{6}{5}$, $\frac{18}{11}$, &c. Which are not Fractions properly speaking, but either whole or mix'd Numbers; and are only in the Form of Fractions, in order to be added, subtracted, multiplied, or divided, &c.

INACCESSIBLE HEIGHT, or DISTANCE, is that as cannot be measured, by reason of some Impediment in the Way; as Water, &c.

INCEPTIVE of Magnitude, is a Word used by Dr. Wallis, expressing such Moments or first Principles, as tho' of no Magnitude themselves are yet capable of producing such.

Thus a Point hath no Magnitude itself, but is Inceptive of it. A Line consider'd one Way, hath no Magnitude as to Breadth, but is capable by its Motion of producing a Surface, which hath Breadth, &c.

INCIDENCE POINT, in Opticks, is that Point in which a Ray of Light is supposed to fall on a Piece of Glass.

INCIDENT RAY, in Catoptricks and Dioptricks. See Ray of Incidence.

INCLINATION, is a Word frequently used by Mathematicians, and signifies the mutual Approach, Tendency, or Leaning of two Lines, or two Planes, towards each other, so as to make an Angle.

The Inclination of two Planes

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is the acute Angle made by two Lines drawn on in each Plane, and perpendicular to their common Section.

INCLINATION of the Axis of the Earth, is the Angle which it makes with the Plane of the Ecliptick, or the Angle between the Planes of the Equator and Ecliptick.

INCLINATION of Meridians, in Dialling, is the Angle that that Hour-Line on the Globe, which is perpendicular to the Dial-Plane, makes with the Meridian.

INCLINATION of a Plane, in Dialling, is the Arch of a Vertical Circle, perpendicular to both the Plane and the Horizon, and intercepted between them.

INCLINATION of the Planes of the Orbits of the Planets to the Plane of the Ecliptick are thus: Saturn's Orbit makes an Angle of two Degrees thirty Minutes, Jupiter's one Degree and one Third, Mars's is a little less than two Degrees, Venus's is three Degrees and one Third, and Mercury's is almost seven Degrees.

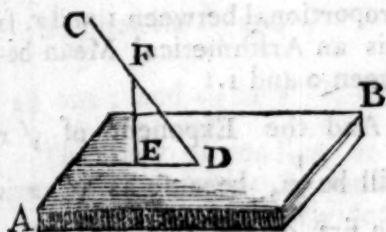
INCLINATION of a Planet, is an Arch of the Circle of Inclination, comprehended between the Ecliptick and the Place of a Planet in his Orbit.

INCLINATION of a Ray, in Dioptricks, is the Angle which this Ray makes with the Axis of Incidence in the first Medium, at the Point where it meets the second Medium.

INCLINATION of a Right Line to a Plane, is the acute Angle which this Right Line makes with another Right Line drawn in the Plane through the Point, where it is also cut by a Perpendicular

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dicular drawn from any Point of the Inclined Line. As the Line CD inclines to the Plane AB , and the Inclination thereof is measur'd by the Angle EDC , made by the Inclined Line CD ,

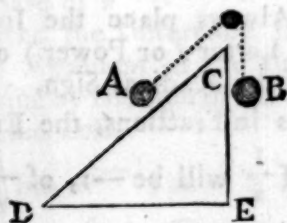


and the Line ED drawn in the Plane from the Point D , through the Point E , where a Perpendicular let fall from any Point F , in the Inclined Line to the Plane, cuts it.

INCLINING DECLINING DIALS, See *Declining Inclining Dials*.

INCLINING DIRECT SOUTH or NORTH DIALS. See *Direct South or North Inclining Dials*.

INCLINED PLANE, is that which makes an oblique Angle with the Horizon. Any Body, as A , laid upon an Inclined Plane, loses Part of its Weight, and the Weight B required to sustain it is to the Weight of



A , as the Height EC of the Plane to the Length DC of it. And from hence it follows that the Inclination of the Plane may be so little, that the greatest

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Weight may be sustain'd on it by the least Power.

INCOMMENSURABLE NUMBERS, are such as have no common Divisor, that will divide them both equally, as 3 and 5.

INCOMMENSURABLE QUANTITIES, are those which have no aliquot Part, or any common Measure that may measure them; as the Diagonal and Side of a Square; for altho' that each of those Lines have infinite aliquot Parts, as the Half, the Third, &c. yet not any Part of the one, be it never so little, can possibly measure the other, as is demonstrated in 117 *El. 10. Euclid*.

INCOMPOSITE NUMBERS, are the same as *Prime Numbers*. See *Prime Numbers*.

INCREMENT, or DECREMENT, is the Increase or Decrease of a Quantity. There is a Learned *Latin Treatise of the Doctrine of Increments*, publish'd by *Brooke Taylor*, F. R. S. See more of this under *Series*.

INCURVATION of the Rays of Light. See *Light and Refraction*.

INDETERMINED PROBLEM, is that which is capable of an infinite Number of Answers: As to find two Numbers, whose Sum, together with their Product, shall be equal to a given Number, or to make a Rhomboides such, that the Rectangle under the Sides be equal to a Given Square; both of which Problems will have infinite Solutions.

INDEX, *Characteristick* or *Exponent*, of a *Logarithm*, is that which shews of how many Places the absolute Number belonging to the Logarithm doth consist, and of what Nature it is, whether Integer or a Fraction,

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tion. Thus, in this Logarithm 2.523421, the Number standing on the Left-Hand of the Point is called the *Index*; and because it is 2, shews you that the absolute Number answering to it, consists of three Places; for 'tis always one more than the Index. If the absolute Number be a Fraction, then the Index of the Logarithm hath a negative Sign, and is marked thus, 2.523421.

INDEX of a Quantity, is that Quantity, shewing to what Power it is to be involved; as a^3 shews that a is to be involved to the third Power; where 3 is the Index, and $a+6^{n+1}$, shews that $a+6$ is to be raised to the Power $n+1$, where $n+1$ is the Index.

If a Series of Geometrical Progressionals be in this Order,

1. x . xx . x^3 . x^4 . x^5 . x^6 . x^7 , &c.

Their Indexes or Exponents will be in Arithmetical Progression, and stand thus,

0. 1. 2. 3. 4. 5. 6. 7.

But if they are Fractions, as

$\frac{1}{x}$ $\frac{1}{x^2}$ $\frac{1}{x^3}$ $\frac{1}{x^4}$ $\frac{1}{x^5}$ $\frac{1}{x^6}$ $\frac{1}{x^7}$.

Then their Exponents will be Negative, and stand thus,

-1. -2. -3. -4. -5. -6. -7.

For if you suppose $x=2$, then will $\frac{1}{x}=1$, and $\frac{1}{xx}=\frac{1}{4}$, and

$\frac{1}{x^3}=\frac{1}{8}$, &c.

Or if you express the Geometrical Series by means of the Exponents, it will stand thus, x^{-1} , x^{-2} , &c. And if it were expressed thus x^0 , then it will be $x^0=1$; because 2 is the Denominator of the Ratio, in which

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Unity is not affected. Thus also

$\frac{1}{x^4}=x^{-4}$, and $\frac{1}{x^3}=x^{-3}$, and $1=x^0$, $x^1=x$, $x^2=xx$, &c.

Also the Exponent of \sqrt{x} will be $\frac{1}{2}$, because as \sqrt{x} is a mean Proportional between 1 and x , so 1 is an Arithmetical Mean between 0 and 1.

And the Exponent of $\sqrt[3]{x}$ will be $\frac{1}{3}$, because as $\sqrt[3]{x}$ is the first of the two mean Proportionals between 1 and x ; so $\frac{1}{3}$ is the first of the two Arithmetical Means between 0 and 1.

For since 1. x . xx . xxx . are continually proportional, therefore their Cubes, or any other Roots, will be also continually proportional, that is, $\sqrt[3]{x} : x (=1.)$
 $\sqrt[3]{x} \cdot \sqrt[3]{xxx} (=x) \div \div$.

So also, 1. x . xx . x^3 . x^4 . x^5 . $\div \div$: Wherefore the Roots of the 5th Power of those Quantities will be $\div \div$: That is, $\sqrt[5]{1} \cdot \sqrt[5]{x} \cdot \sqrt[5]{x^2} \cdot \sqrt[5]{x^3} \cdot \sqrt[5]{x^4} \cdot \sqrt[5]{x^5} (=x.)$

Also, for the same Reason, the Exponent of $\sqrt[5]{x^4}$, will be $\frac{4}{5}$.

N.B. Always place the Index of the Letter (or Power) over that of the Radical Sign.

Thus in Fractions, the Exponent of $\frac{1}{x}$ will be -1, of $\frac{1}{\sqrt{x^3}}$

will be $-\frac{3}{2}$, of $\frac{1}{\sqrt[3]{x^5}}$ will be $-\frac{5}{3}$

of $\frac{1}{\sqrt{x^7}}$ will be $-\frac{7}{2}$, &c.

N.B.

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N.B. \sqrt{x} , and $x^{\frac{1}{2}}$, or $\sqrt[3]{x}$ and $x^{\frac{1}{3}}$, or $\sqrt{x^4}$, and $x^{\frac{4}{2}}$, are only two different Ways of Notation for one and the same Thing; the former in the old, the latter in the new Way.

So likewise $\frac{1}{x^2}$ and x^{-2} are all one; and $\frac{1}{x^3}$ is x^{-3} , &c.

The Way of reading or expressing Quantities so denoted, is thus, x^{-3} is Unity divided by the Cube of x , and if it were $x^{\frac{7}{3}}$, it must be read, Unity or One divided by the Cube-Root of the 7th Power of x .

Note also, That the Sum of any two Numbers or Quantities, in any Geometrick Progression, makes the Exponents of the Product of those two Terms.

Thus, $x^{\frac{1}{2}} + \frac{1}{3}$, or $x^{\frac{5}{6}}$, is the Way of expressing the Product of $x^{\frac{1}{2}}$ into $x^{\frac{1}{3}}$, and $x^{-\frac{1}{3}} + \frac{1}{3}$, or $x^{-\frac{2}{3}}$ is the Product of $x^{-\frac{1}{3}}$ into $x^{\frac{1}{3}}$.

Also $x^{-\frac{1}{3}} - \frac{1}{3}$, or $x^{-\frac{2}{3}}$ is the Product of $x^{-\frac{1}{3}}$ into itself, or the Square of $x^{-\frac{1}{3}}$.

And the Difference between the Exponent of the Quotient arising by Division of the Greater by the Less.

Thus $x^{\frac{1}{2}} - \frac{1}{3}$, or $x^{\frac{1}{6}}$ is the Exponent of the Quotient of $x^{\frac{1}{2}}$ by $x^{\frac{1}{3}}$. &c.

Let p represent the Exponent of N , any Number at pleasure; and let $p=1$.

Then will $N^p = N$, N^{p+1}

$= N^2$, and $N^{p+2} = N^3$, $N^{p+3} = N^4$, &c.

Or if $p=3$; then will $N^p = N^3$, and $N^{p+3} = N^6$, &c.

And negatively, $N^{-p} = N^{-3}$, and $N^{p+3} = N^6$, &c.

Also, as o is an Arithmetical Mean between a Positive and a Negative Quantity equally distant from it; (i.e.) -6 . o . 6 are Arithmetically Proportional: So is 1 a Geometrical Mean between an Affirmative and Negative Power, at equal Distances from it: That is, N^{-p} . 1 . N^p .

Wherefore $1 = N^{-p} \times N^p$.

And dividing all by N^p , $\frac{1}{N^p} = N^{-p}$. So that $\frac{1}{N^p}$ is all one with N^{-p} .

And to add some Examples of Multiplication and Division in

this Way, $\frac{1}{x} \times \frac{1}{\sqrt{x^5}} = x^{-1} \times x^{-\frac{1}{2}} = x^{-\frac{3}{2}}$
 $x x^{\frac{1}{3}} = x^{-\frac{1}{3}} \times x^{\frac{1}{3}} = x^{-\frac{2}{3}} = \frac{1}{x^{\frac{2}{3}}}$

$= \frac{1}{\sqrt[3]{x^2}}$, &c.

And $\frac{1}{\sqrt[3]{x^5}}$ divided by $\frac{1}{x}$ will

stand in this Notation; thus,

$\frac{1}{x} \div \frac{1}{\sqrt[3]{x^5}} = \frac{1}{x} \times \sqrt[3]{x^5} = (x^{-1}) x^{\frac{5}{3}} = x^{-\frac{2}{3}}$
 $x^{-\frac{2}{3}} = (x^{-\frac{2}{3}}) = \frac{1}{\sqrt[3]{x^2}}$, &c.

INDICTION. See Cycle of Indiction.

INDIVISIBLES, in Geometry, are such Elements or Principles as any Body or Figure may ultimately

I N

mately be resolved into; and these Elements or Indivisibles are in each peculiar Figure supposed to be infinitely small.

1. With regard to which Notion, a Line may be said to consist of Points, a Surface of Parallel Lines, and a Solid of Parallel and Similar Surfaces; and then, because each of these Elements is supposed indivisible, if in any Figure a Line be drawn thro' the Elements perpendicularly, the Number of Points in that Line will be the same Number of the Elements.

2. Whence we may see that a Parallelogram, Prism, or Cylinder, is resolvable into Elements or Indivisibles, all equal to each other, parallel and like to the Base. A Triangle into Lines parallel to the Base, but decreasing in Arithmetical Proportion, and so are the Circles which constitute the Parabolick Conoid, and those which constitute the Plane of a Circle, or the Surface of an Isosceles Cone.

3. A Cylinder may be resolved into Cylindrical-Curve Surfaces, having all the same Height, and continually decreasing inwards, as the Circles of the Base do, on which they insist.

4. This Method of Indivisibles, is only the ancient Method of Exhaustions, a little disguised and contracted. It was first introduced by *Cavallerius*, in his *Geometria Indivisibilium*, Anno Dom. 1635. Pursued after by *Torricellius* in his Works, printed 1644. And again, by *Cavallerius* himself in another Treatise, publish'd 1647. And is now allowed to be of excellent Use in the Shortening of Mathematical Demonstrations.

I N

INFINITE, or INFINITELY GREAT QUANTITY, is that which has no Bounds, Ends, or Limits.

INFINITELY SMALL QUANTITY, is that which is so very small, as to be incomparable to any finite Quantity, or which is less than any assignable Quantity.

1. No infinite Quantity can be augmented or lessen'd, by adding or taking from it a finite Quantity: Neither can a finite Quantity be augmented or lessen'd, by adding or taking from it an Infinitely small Quantity.

2. If there be four Proportionals, and the first is infinitely greater than the second; then the third will be infinitely greater than the fourth.

2. If a finite Quantity be divided by an infinitely small one, the Quotients will be an infinitely great one; and if a finite Quantity be multiply'd by an infinitely small one, the Product will be an infinitely small one.

But if by an infinitely great one, the Product will be a finite Quantity.

If an infinitely small Quantity be multiplied or drawn into an infinitely great one, the Product will be a finite one.

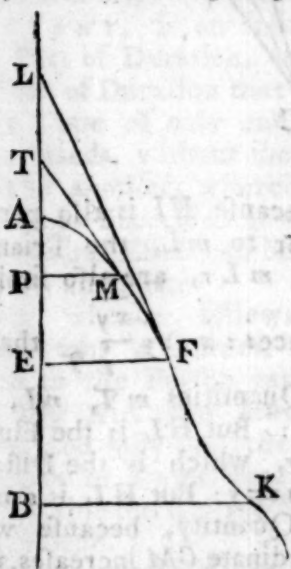
INFINITE SERIES. See *Series*.

INFLECTION, in Opticks, is a Multiply Refraction of the Rays of Light, caused by the unequal Density of any Medium, whereby the Motion or Progress of the Ray is hinder'd from going on in a Right Line, and is inflected or deflected by a Curve, saith the ingenious Dr. *Hook*, pag. 217. who first took Notice of this Property in his *Micrographia*. And this, he saith, differs both

both from Reflection and Refraction, which are both made at the Superficies of the Body, but this in the Middle of it within.

Sir Isaac Newton, discovered also by plain Experiment, this Inflexion of the Rays of Light, and Mr. De la Hire saith he found, that the Beams of the Stars being observed in a deep Valley, to pass near the Brow of an Hill, are always more refracted than if there were no such Hill, or the Observations were made on the Top thereof, as if the Rays of Light were bent down into a Curve, by passing near the Surface of the Mountain.

INFLECTION-POINT of any Curve, in Geometry, signifies the Point or Place where the Curve begins to bend back again a contrary Way. When a Curve Line, as AFK is partly Con-



cave and partly Convex towards the Right Line AB , or towards a fix'd Point, then the Point E , that divides the Concave from the Convex Part, and so is at the

Beginning of one, or the End of the other, is called the *Inflexion Point*, or *Point of Inflexion*, as long as the Curve being continu'd towards F , keeps its Course the same. But the Point K is called the *Point of Retrogression*, where it begins to reflect back again towards that Part or Side where it took its Original.

1. If thro' the Point F be drawn the Ordinate EE , as also the Tangent FL , and from any Point, as M on the same Side, as AF be drawn the Ordinate MP , as likewise the Tangent MT ; then in those Curves that have a Point of Inflexion, the Absciss AP continually increases, and the Part AT of the Diameter, intercepted between the Vertex of the Diameter, and the Tangent MT , increases until the Point P falls into E , after which it again begins to diminish; whence the Line AT must become a *Maximum* AL , when the Point P falls in the Point E .

2. In those Curves that have a Point of Retrogression, the Part AT increases continually, and the Absciss increases so long, till the Point T falls in L ; after which it again diminishes. Whence AP must become a *Maximum*, when the Point T falls in L .

3. If $AE = x$, $EF = y$, then will $AL = \frac{y^2}{x} - x$, whose Fluxion,

which is $\frac{\dot{y}^2 x - y^2 \dot{x}}{x^2}$, sup-

posing \dot{x} constant, being divided by x , the Fluxion of AL must become nothing, that is,

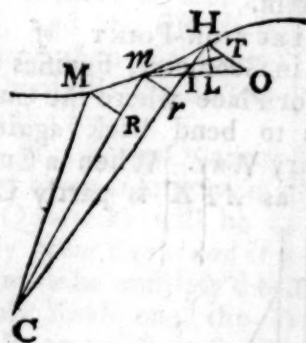
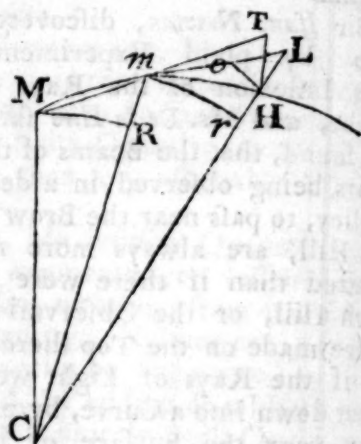
$-\frac{\dot{y} \ddot{y}}{y^2} = 0$, so that multiplying by y^2 ,

\dot{y}^2 , and dividing by $-y$, $\ddot{y} = 0$; which is a general Form for finding F the Point of Inflexion or Retrogression in those Curves, whose Ordinates are parallel to one another. For the Nature of the Curve AFK being given, the Value of \dot{y} may be found in \dot{x} ; and taking the Fluxion of this Value, and supposing \dot{x} invariable, the Value of \ddot{y} will be found in x , which being put equal to nothing, or Infinity serves in either of these Suppositions to find such a Value of AE , as that the Ordinate EF shall intersect the Curve AFK in F , the Point of Inflexion or Retrogression.

But to determine the Inflexion or Retrogression in Curves, whose Semi-Ordinates CM, Cm , are drawn from the fixed Point C , draw CM infinitely near to Cm , and make $mH = Mm$, let Tm touch the Curve in M ; now the Angles CmT, CMm are equal, and so the Angle CmH , while the Semi-Ordinates increase, does decrease, if the Curve is Concave towards the Centre C , and increases if the Convexity turns towards it. Whence this Angle, or which is the same, its Measure will be a *Minimum*, or *Maximum*, if the Curve has a Point of Inflexion or Retrogression; and so may be found, if the Arch TH , or Fluxion of it, be made equal to 0, or Infinity. And in order to find the Arch TH , draw mL , so that the Angle TmL be equal to mCL ; then if $Cm = y$, $mr = x$, $mT = t$, we shall have $y : x :: t : \frac{\dot{x}}{\dot{y}}$. Again draw the Arch HO

to the Radius CH ; then the

small Right Lines mr, OH , are parallel; and so the Triangles oLH, mLr , are similar;



but because HI is also perpendicular to mL , the Triangles LHI, mLr , are also similar:

Whence $t : x :: y \frac{\dot{x}}{\dot{y}}$, that is,

the Quantities mT, mL , are equal: But HL is the Fluxion of Mr , which is the Distance of $Cm = y$: But HL is a negative Quantity, because while the Ordinate CM increases, their Difference rH decreases; whence $xx + yy - \dot{y}\dot{y} = 0$, which is a general Equation for finding the Point of Inflexion or Retrogression.

I N

INFORMED STARS, are such of the fixed Stars, as are not cast into, or ranged under any Form. See *Sporades*.

INGRESS, in Astronomy, signifies the Sun's entering the first Scruple of one of the four Cardinal Signs, especially *Aries*.

INHARMONICAL RELATION, a Term in Musick. See *Relation Inharmonical*.

INSCRIBED, in Geometry, a Figure is said to be inscribed in another, when all the Angles of the Figure inscribed touch either the Angles, Sides, or Planes of the other Figure.

INSCRIBED BODIES. See *Regular Bodies*.

INORDINATE PROPORTION, is where the Order of the Terms are disturbed.

INSCRIBED HYPERBOLA, is such an one as lies entirely within the Angle of its Asymptotes, as the Conical *Hyperbola* doth.

INSTANT, is an infinitely small Part of Duration, or it is that Part of Duration that takes up the Time of only one Idea in our Minds, without the Succession of another, wherein we perceive no Succession at all.

No natural Effect can be produced in an Instant.

From whence follows the Reason why a Burden seems lighter to the Person carrying it in the Air, the faster he moves; and why the faster any one slides or scates upon Ice, the less liable the Ice is to break, or even bend.

INTACTÆ, are Right Lines to which Curves do continually approach, and yet never meet with them. These are usually called *Asymptotes*. Which see.

I N

INTEGERS, from the *Latin Integum*, signifies, in Arithmetick, whole Numbers, in Contradistinction to Fractions.

INTENSION, in Natural Philosophy, signifies the Increase of the Power, or Energy of any Quality, such as Heat, Cold, &c. for all the Qualities, they say, they are intended and remitted, that is capable of Increase and Diminution.

The Intension of all Qualities increases reciprocally, as the Squares of the Distances from the Centre of the radiating Quality decreases.

INTERCALARY DAY, is the odd Day put in or inserted in the Leap-Year.

INTERCEPTED AXIS, a Term in Conick Sections, signifying the same with *Abscissa*. Which see.

INTERCOLUMNATION, in Architecture, is the Space between two Columns, which, in the *Dorick* Order, is regulated according to the Distribution of Ornaments in the Frieze; but in other Orders, according to *Vitruvius*, is of five different Kinds, viz. *Pienostyle*, *Systyle*, *Eustyle*, *Diastyle*, and *Araostyle*.

This the *Latins* express by the Word *Intercolumnium*.

INTEREST, is the Sum reckoned for the Lot or Forbearance of some principal Sum lent for (or due at) a certain Time, according to some certain Rate; and therefore is called *Principal*, because it is the Sum that procreates the Interest, or from which the Interest is reckoned, and is either Simple or Compound.

INTEREST SIMPLE, is counted from the Principal only, and is

is easily computed by the Simple or Compound Golden Rule, thus:

Let the principal Sum of the Interest be put into the first Place, and that which betokeneth Time be in the second Place, and the remaining in the third. Under this conditional Part place the two other Terms, each under its like, and there will be a Blank to supply under one of those above, either under the first, second, or third. See *Compound Interest*.

INTERIOR POLYGON. See *Polygon Interior*.

INTERIOR TALUS. See *Talus*.

INTERNAL ANGLES. See *Angles Internal*.

INTERRUPTION, as some call it, is the same with *Disjunction* or *Proportion* in Geometry, and is noted thus, ($::$) and signifieth the breaking off of the Ratio in the Middle of four Disjunct or Discrete Proportionals; as $A : B :: C : D$, that is, as A is to $B ::$ so is C to D .

INTERSECTION, in Mathematicks, signifies the cutting of one Line or Plane by another; thus we say, that the mutual Intersection of two Planes is a Right Line.

INTERSTELLAR, a Word used by some Authors to express those Parts of the Universe that are without and beyond our solar System, and which are supposed as Planetary Systems moving round each Fixed Star as the Centre of their Motion, as the Sun is of ours; and if it be true, as 'tis not improbable, that each Fixed Star may thus be a Sun to some habitable Orbs that may move round it, the In-

terstellar World will be infinitely the great Part of the Universe.

INTERTIES, in a Building, are those small Pieces of Timber that lie horizontally between the Sommers, or between them and the Cell or Reason.

INTERVAL, in Musick, is the Distance or Difference between any two Sounds, whereof one is more grave, and the other more acute. They make several Divisions of an Interval, as first into Simple and Compound. The Simple Intervals are the Octave, and all that are within it, as the second, third, fourth, fifth, sixth, and seventh, with their Varieties. Compound ones are all those that are greater than an Octave, as the ninth, tenth, eleventh, &c. with their Varieties.

An Interval is also divided into Just or True, and into False. All the above mentioned Intervals, with their Varieties, whether *Major* or *Minor*, are Just; but the Diminutive or Superfluous ones are all False. An Interval is also divided into a Consonance and Dissonance. Which see.

INTERVAL of the Fits of easy Reflexion, and of easy Transmission of the Rays of Light, is the Spaces between every Return of the Fit and the next Return.

These Intervals Sir Isaac Newton shews how to collect, and thence to determine whether the Rays shall be reflected or transmitted at their subsequent Incidence on any pellucid Medium.

INTESTINE Motion of the Parts of Fluids. Where the attracting Corpuscles of any Fluid are elastick,

elastick, they must necessarily produce an Intestine Motion; and this, greater or lesser, according to the Degrees of their Elasticity and attractive Forces.

For two Elastick Particles, after Meeting, will fly from one another (abstracting from the Resistance of the Medium) with the same Degree of Velocity that they met together with.

But when, in leaping back from one another, they approach other Particles, their Velocity will be encreased.

INVERSE Method of Fluxions, is the Method of finding the flowing Quantity from the Fluxion given, and is the same with what the foreign Mathematicians call the *Calculus Integralis*.

The flowing Quantity of a Fluxion may be had by adding 1 to the Index of the flowing Quantity, and dividing the Sum by the fluxionary Letter, and by the new Index, and the Quotient is the flowing Quantity of that Fluxion.

As if the flowing Quantity of the Fluxion $mx^{m-1}x$ were required, increase the Index of the flowing Quantity x by 1, and then we have $mx^m x$, which divide by the new Index m , and by the fluxionary Letter x , and there will arise x^m for the flowing Quantity required.

INVERSE Method of Tangents, is the Method of finding an Equation to express the Nature of a Curve in an Equation expressed in the nearest Terms.

INVERSE PROPORTION, or Proportion by Inversion. See Proportion.

INVERSE RATIO, is the Assumption of the Consequent to

the Antecedent, like as the Antecedent to the Consequent; as if $A : B :: C : D$; then by Inversion of Ratio's $B : A :: D : C$.

INVOLUTE FIGURES. The Curve AMM (see *Evolute Curves*) is what is called an *Involute Curve Figure*.

INVOLUTION, in Algebra, is the raising up any Quantity from its Root to any other assigned; as suppose $a+b$ were to be squared, or raised up to its Second Power, they say involve $a+b$, that is, multiply it into itself, and it will produce $aa + 2ab + bb$.

INWARD FLANKING ANGLE, in Fortification, is made by the Courtin, and the Razant Flanking Line of Defence.

IONICK ORDER, in Architecture, is the third Order, and is a kind of Mean between the the strong and delicate Orders. Its Capital is adorned with Volutes, and its Cornice with Denticles.

1. The Promotions of this Pillar, as they are taken from the famous one in the Temple of *Fortuna Virulis* at Rome, now the Church of *St. Mary the Egyptian*, are these:

2. The entire Order from the Superficies of the Area to the Cornice, are twenty two Modules, or eleven Diameters.

3. The Column, with its Base and Capital, contains eighteen Modules.

4. The Entablature (*i. e.* the Architrave, Frieze, and Cornice) contain four Modules.

5. The Voluta of the Capital is of an oval Form.

6. The Columns in this Order are often hollowed, and furrowed with twenty four Gutters;

and sometimes 'tis done only to the third Part of the Column, reckoning from the Bottom, and then that third Part hath its Gutters filled with little Rods or Battoons, all the Parts of the Hollow above being left empty.

IRIS, is that fibrous Circle next to the Pupil of the Eye, distinguish'd with Variety of Colours. See *Uvea Membrana*.

'Tis so called from its Similitude to a Rainbow, (in *Latin Iris*.)

Also those changeable Colours which sometimes appear in the Glasses of Telescopes, Microscopes, &c. are called *Ires* for the same Reason; as is that Coloured Spectrum, which a Triangular Prismatick Glass, will project on a Wall, when placed (at a due Angle) in the Sun-Beams. See *Rainbow*.

IRRATIONAL NUMBERS. See *Irrational Numbers*.

IRRATIONAL QUANTITIES. See *Rational Quantities*.

IRREGULAR BODIES, are Solids which are not terminated by equal and like Surfaces.

IRREGULAR FORTIFICATION. See *Fortification*.

IRREGULAR LINES OR CURVES. See *Regular*.

ISAGON, in Geometry, is sometimes used for a Figure consisting of equal Angles.

ISLES, in Architecture, are Sides, or Wings of a Building.

ISOCHRONE. Vibrations of a Pendulum are such as are made in the same Space of Time, as all the Vibrations or Springs of the same Pendulum are; whether the Arks it describes be longer or shorter; for when it describes a shorter Ark, it moves so much the slower, and when

a long one, proportionably faster.

ISOCHRONAL LINE, is that in which a heavy Body is supposed to descend without any Acceleration: And the excellent *G. G. Leibnitz*, in the *Act. Erud. Lips.* for Feb. 1689. hath a Discourse on this Subject. In which he shews, That an heavy Body, with a Degree of Velocity acquired by the Descent from any Height, may descend from the same Point by an infinite Number of Isochronal Curves, and which are all of the same Species, differing from one another only in the Magnitude of their Parameters; such as are all the Quadrato Cubical Paraboloids, and consequently similar to one another.

He shews also there, how to find a Line, in which a heavy Body descending, shall recede uniformly from a given Point, or approach uniformly to it.

ISOMERIA, in Algebra, is the same with *Conversion of Equations*, (See *Equations*, N^o. 1.) or of *Clearing any Equation from Fractions*.

ISOPERIMETRICAL FIGURES, in Geometry, are such as have equal Perimeters or Circumferences.

1. Of Isoperimetrical Regular Figures, that is the greatest that contains the greater Number of Sides, or the most Angles, and consequently a Circle is the greatest of all Figures that have the same Ambit as it has.

2. Of two Isoperimetrical Triangles, having the same Base, whereof two Sides of one are equal, and of the other unequal, that is the greater, whose two Sides are equal.

3. Of Isoperimetrical Figures, whose Sides are equal in Number, that is the greatest, which is Equilateral and Equiangular. From hence follows that common Problem of making the Hedging or Walling, that will wall in one Acre, or even any determinate Number of Acres, (which call a ,) will hedge or wall in any greater given Number of Acres, be it what it will. Which let be b , as likewise always a Square. Now call x one Side of an Oblong, (whose Area is the Number of Acres a) then will

$$\frac{a}{x} \text{ be the other Side, and } 2\frac{a}{x} + 2x$$

will be the Ambit of the Oblong. Which must be equal to four Times the Square Root of b , that is, $2\frac{a}{x} + 2x = 4\sqrt{b}$. Whence the Value of x will be easy had, and you may make infinite Numbers of Squares and Oblongs that have the same Ambit, and yet shall have different Given Area's. See the Operation.

$$\text{Let } \sqrt{b} = d.$$

$$\text{Then } \frac{2a + 4xx}{x} = 4d.$$

$$\text{And } a + 2xx = 2dx.$$

$$\text{Also } 2xx - 2dx = -a.$$

$$\text{And } xx - dx = -\frac{a}{2}.$$

$$\text{And } xx - dx + \frac{1}{4}dd = -\frac{a}{2} + \frac{1}{4}dd.$$

$$x - \frac{1}{2}d = \sqrt{-\frac{a}{2} + \frac{1}{4}dd}.$$

Whence

$$x = \sqrt{-\frac{a}{2} + \frac{1}{4}dd} + \frac{1}{2}d.$$

As if one Side of the Square be 10, and one Side of an Oblong be 19, and the other 1, then will

the Ambits of that Square and Oblong be equal, viz. each 40, and yet the Area of the Square will be 100, and of the Oblong but 19.

ISOSCELES TRIANGLE. See Triangle.

ISTHMUS, in Geography, is a little Neck, or Part of Land joining a Peninsula to the Continent.

JULIAN PERIOD, is a Cycle of 7980 Consecutive Years, produced by the continual Multiplication of the three Cycles, viz. That of the Sun of 28 Years, that of the Moon of 19 Years, and that of the Indiction of 15 Years; so that this Epocha, although but artificial or feigned, (and which was the Invention of the famous *Julius Scaliger*) is yet of very good Use; in that every Year within the Period is distinguishable by a certain peculiar Character; for the Year of the Sun, Moon, and Indiction, will not be the same again, till the whole 7980 Years be revolved. *Scaliger* fixed the Beginning of this Period 764 Years before the Creation.

For the finding the Year of the Julian Period, you have this Rule,

Multiply the Solar Cycle by 4845, the Lunar by 4200, and the Indiction by 6916:

Then divide the Sum of the Products by 7980, and the Remainder of the Division (without having regard to the Quotient) shall be the Year enquired after.

JULIAN YEAR, is the old Account of the Year, instituted by *Julius Caesar*, which to this Day we use in England, and call it the Old Style, in Contra-Distinction

to the New Account, framed by Pope Gregory, which is eleven Days before ours, and is called the *New Style*.

JUPITER, the Name of one of the Planets. This is the biggest of all the Planets: It is distant from the Sun at a mean Rate 5201. Its Excentricity is 250. The Inclination of its Orbit is $1^{\circ} 20'$. Its Periodical Time is 43332 Days, 12 Hours, and it revolves about its Axis in nine Hours 56 Minutes. The Magnitude of *Jupiter* is about 2460 Times greater than our Earth.

1. In the Year 1664, *Campani*, by help of an excellent Telescope, observ'd certain Protuberances, and Inequalities in the Surface of this Planet. As also the Shadow of his Satellites, and kept his Eye upon them till they went off the Disk.

2. In the same Year, *May 9*. two Hours, *P. M.* Mr. *Hook*, with a Telescope of twelve Foot, observed a small Spot in the biggest of the three obscurer Belts of *Jupiter*; and within two Hours after he found that the said Spot had moved from East to West above half the Length of the Diameter of *Jupiter*.

3. Mr. *Cassini* observed also, near the same Time, a permanent Spot in the Disk of *Jupiter*; by whose Help he not only found that *Jupiter* turns about upon his own Axis, but also the Time of such Conversion, which he estimates to be nine Hours, and 56 Minutes: Which was also confirm'd by better Observations of a Spot in the Year 1691, the Equatorial Diameter of *Jupiter* to his Polar one. Sir *Isaac Newton* computes to be as $40 \frac{1}{3}$ to $39 \frac{1}{3}$.

K.

KALENDAR. See *Calendar*.

KALENDS. See *Calends*.

KEY, in Musick, is a certain Tone, whereto every Composition, whether it be long or short, ought to be fitted or designed; and this Key is said to be either flat or sharp, not in respect of its own Nature, but with relation to the flat or sharp Third, which is joined with it.

KNOTS. There are two Sorts of Knots used at Sea: One they call a *Bowling-Knot*, because by this Knot the Bowling-Bridles are fasten'd to the Crenyles. This is very fast, and will not slip.

The other is a *Wall-Knot*; which is a round Knob, or Knot, made with three Strands of a Rope. This Knot serves for the Top-Sail, Sheet, and Stoppers.

The Divisions of the Log-Line are thus called. These are usually seven Fathom, or forty two Feet asunder, but they should be fifty Feet; and then as many Knots as the Log-Line runs out in half a Minute, so many Miles doth the Ship sail in an Hour; supposing her to keep going at any equal Rate, and allowing for Yaws, Lee-Way, &c.

L.

LABEL, is a long thin Brass Ruler, with a small Sight at one End, and a Centre-Hole at the other, commonly used with

L A

with a Tangent-Line on the Edge of a Circumferentre, to take Altitudes, &c.

LACUNAR, in Architecture, is an arched Roof or Ceiling, more especially the Planking or Flooring above the Porticoes.

LADLE, an Instrument to load great Guns with Powder. It ought to be so proportioned, that two Ladles-full may charge the Piece; therefore their Breadth must be two Diameters of the Shot, and their Length for double-fortified Cannon 2 and $\frac{1}{4}$ of the Shot; for ordinary Cannon it must not exceed 2; but for Culverins and Demi-Culverins, it may be three Diameters of the Shot, and 3 and $\frac{1}{2}$ for lesser Pieces, in order to load at twice: If you will load at once, this Length of the Ladle must be doubled. And observe this, that a Ladle nine Balls in Length, and two Balls in Breadth, will hold just the Weight of the Iron Shot in Powder.

LAMPADIAS, a kind of bearded Comet, resembling a burning Lamp, being of several Shapes; for sometimes its Flame or Blaze runs tapering upwards like unto a Sword, and sometimes it is double or treble pointed.

LANGREL-SHOT, is a sort of Shot used at Sea. It is made of two Bars of Iron, with a Joint in the Middle, by which Means it can be shorten'd, and so put the better into the Gun; and at each End there is an Half-Bullet, either of Lead or Iron. When 'tis discharged, it flies out at Length, and is of Use to cut the Enemy's Rigging, &c.

LARBOARD, the Left-Hand Side of a Ship, when you stand with your Face to the Head.

L A

LARMIER, a flat square Member in Architecture, which is placed on the Cornice below the Cymatium, and jets out farthest; being so called from its Use, which is to disperse the Water, and to cause it to fall at a Distance from the Wall, Drop by Drop, or, as it were, by Tears: For *Larme*, in French, signifies Tear. See *Corona*.

LATERAL EQUATION, in Algebra, is the same with simple Equation, which has but one Root, and may be constructed by Straight Lines only.

LATION, is the Translation or Motion of a Body from one Place to another in a Right Line; and so is much the same as *Local Motion*.

LATITUDE of a Place, is an Arch of the Meridian of that Place, intercepted between its Zenith and the Equator; or 'tis an Arch of the Meridian intercepted between the Pole and the Horizon; and therefore is called the *Poles Height*.

LATITUDE, in Navigation, is the Distance of a Ship from the Equinoctial, either North or South, and is counted on the Meridian; so that if a Ship sails towards the Equinoctial, she is said to *depress the Pole*; but if she sails from the Equinoctial, either North or South, her Way gained thus is called *Her Difference of Latitude*.

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LATITUDE HELIOCENTRICK of a Planet. See *Heliocentrick*.

LATUS RECTUM, a Term in Conicks, being the same with the Parameter. Which see.

to the New Account, framed by Pope Gregory, which is eleven Days before ours, and is called the *New Style*.

JUPITER, the Name of one of the Planets. This is the biggest of all the Planets: It is distant from the Sun at a mean Rate 5201. Its Excentricity is 250. The Inclination of its Orbit is $1^{\circ} 20'$. Its Periodical Time is 43332 Days, 12 Hours, and it revolves about its Axis in nine Hours 56 Minutes. The Magnitude of *Jupiter* is about 2460 Times greater than our Earth.

1. In the Year 1664, *Campani*, by help of an excellent Telescope, observ'd certain Protuberances, and Inequalities in the Surface of this Planet. As also the Shadow of his Satellites, and kept his Eye upon them till they went off the Disk.

2. In the same Year, *May 9*. two Hours, *P. M.* Mr. *Hook*, with a Telescope of twelve Foot, observed a small Spot in the biggest of the three obscurer Belts of *Jupiter*; and within two Hours after he found that the said Spot had moved from East to West above half the Length of the Diameter of *Jupiter*.

3. Mr. *Cassini* observed also, near the same Time, a permanent Spot in the Disk of *Jupiter*; by whose Help he not only found that *Jupiter* turns about upon his own Axis, but also the Time of such Conversion, which he estimates to be nine Hours, and 56 Minutes: Which was also confirm'd by better Observations of a Spot in the Year 1691, the Equatorial Diameter of *Jupiter* to his Polar one. Sir *Isaac Newton* computes to be as $40 \frac{3}{5}$ to $39 \frac{2}{5}$.

K.

KALENDAR. See *Calendar*.

KALENDS. See *Calends*.

KEY, in Musick, is a certain Tone, whereto every Composition, whether it be long or short, ought to be fitted or designed; and this Key is said to be either flat or sharp, not in respect of its own Nature, but with relation to the flat or sharp Third, which is joined with it.

KNOTS. There are two Sorts of Knots used at Sea: One they call a *Bowling-Knot*, because by this Knot the Bowling-Bridles are fasten'd to the Crenyles. This is very fast, and will not slip.

The other is a Wall-Knot; which is a round Knob, or Knot, made with three Strands of a Rope. This Knot serves for the Top-Sail, Sheet, and Stoppers.

The Divisions of the Log-Line are thus called. These are usually seven Fathom, or forty two Feet asunder, but they should be fifty Feet; and then as many Knots as the Log-Line runs out in half a Minute, so many Miles doth the Ship sail in an Hour; supposing her to keep going at any equal Rate, and allowing for Yaws, Lee-Way, &c.

L.

LABEL, is a long thin Brass Ruler, with a small Sight at one End, and a Centre-Hole at the other, commonly used with

L A

with a Tangent-Line on the Edge of a Circumferentre, to take Altitudes, &c.

LACUNAR, in Architecture, is an arched Roof or Ceiling, more especially the Planking or Flooring above the Porticoes.

LADLE, an Instrument to load great Guns with Powder. It ought to be so proportioned, that two Ladles-full may charge the Piece; therefore their Breadth must be two Diameters of the Shot, and their Length for double-fortified Cannon 2 and $\frac{1}{2}$ of the Shot; for ordinary Cannon it must not exceed 2; but for Culverins and Demi-Culverins, it may be three Diameters of the Shot, and 3 and $\frac{1}{2}$ for lesser Pieces, in order to load at twice: If you will load at once, this Length of the Ladle must be doubled. And observe this, that a Ladle nine Balls in Length, and two Balls in Breadth, will hold just the Weight of the Iron Shot in Powder.

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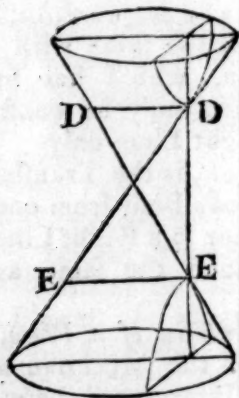
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LE

LATUS TRANSVERSUM of the *Hyperbola*, is a Right Line lying between the Vertexes of the two opposite Sections; or that Part of the common Axis, which is between the Vertexes of the Upper and Lower Cone, as the Line *ED*, in the following Figure.



LATUS PRIMARIUM, is a Right Line belonging to a Conick Section, drawn through the Vertex of the Section of the Cone, and within it, as the Line *EE* or *DD* in the preceding Figure.

LEAP-YEAR, or **BISSEXTILE**, is every fourth Year; and is so called from its leaping a Day more that Year than in a Common Year: For in the Common Year any fixed Day of a Month changeth successively the Day of the Week: If the Year be divided by 4; if nothing remains, 'tis Leap-Year; but if 1, 2, or 3, it is so many Years after Leap-Year.

LEAVER. See *Lever*.

LEAVES, are the Notches of the Pinion of a Watch. See *Pinion*.

LEE, a Sea Term, by which is generally meant the Part opposite to the Wind.

LE

LEGS of a *Triangle*. When one Side of a Triangle is taken as a Base, the other two are called *Legs*.

LEMMA, is a Term used chiefly by Mathematicians, and signifies a Proposition, which serves previously to prepare the Way for the more easy Apprehension of the Demonstration of some Theorem, or for the Construction of some Problem.

LENS, is a Term in Opticks for a small Convex, or Plano-Convex, a Concave, or Concavo-Convex Glass.

LEO, is the fifth of the twelve Signs of the *Zodiack*, and is mark'd thus ♌.

LEPUS, the *Hare*, a Southern Constellation, containing thirteen Stars.

LESSER CIRCLES of the *Sphere*, are those whose Planes do not pass through the Centre of the Sphere; and which do not divide the Globe into two equal Parts, but are parallel to the greater Circles; as the Tropicks and Polar Circles, and all Parallels of Declination and Altitude; which latter being parallel to the Horizon, are called *Almacanters*.

LEVANT, in Geography, is properly the Eastern-Side of any Continent or Country, or that on which the Sun rises; but now, with our Seamen, it signifies the *Mediterranean Sea*, and especially the Eastern Part of it; and our Trade thither is called the *Levant Trade*; and a Wind that blows from thence out of the *Streights-Mouth*, is called a *Levant Wind*.

LEVEL, is an Instrument whereby we find an Horizontal Line, and continue it out at Pleasure, and by this Means find the true Level.

L E

Level for conveying Water to supply Towns, make Rivers navigable, drain Bogs, &c. Of these Instruments there are several Kinds, of which a very good one for short Distances, is this following; which consists of a round Tube of Brass or other Matter about three Foot long, and about an Inch in Diameter, bent up square at both Ends to receive two Glass-Tubes of three or four Inches, fasten'd to them. In this Tube is pour'd common or colour'd Water through one of the Ends, until there is so much as to appear in the Glass-Tubes. This Instrument being

L E

set upon a Three-legged Staff, is fit for use.

There are many more nice and compound Instruments of this Kind; as may be seen in Mr. De la Hire's and Picard's Treatises of Levelling; in Mr. Bion's Book of Mathematical Instruments, and in the Transactions of the London and Paris Royal Societies.

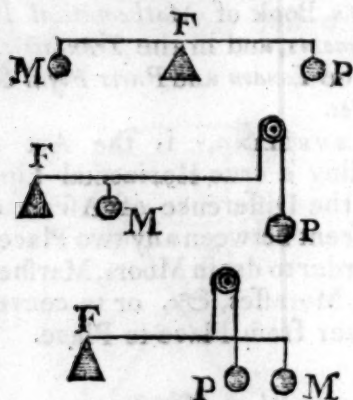
LEVELLING, is the Art of finding a true Horizontal Line, or the Difference of Ascent or Descent between any two Places, in order to drain Moors, Marshes, and Morasses, &c. or to convey Water from Place to Place.

If a Station be taken more than fifty French Fathoms, it must be corrected from the following Table of Corrections.

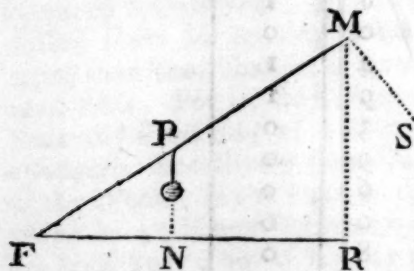
Stations.	Corrections.	Lines.	Parts.
Fathoms.	Inches.		
50	0	0	I
100	0	I	I
150	0	3	0
200	0	5	I
250	0	8	I
300	I	0	0
350	I	4	I
400	I	9	I
450	2	3	0
500	2	9	0
550	3	6	0
600	4	0	0
650	4	8	0
700	5	4	0
750	6	3	0
800	7	I	0
850	7	II	I
900	8	II	0
950	10	0	0
1000	II	0	0

LE

LEVER, the second mechanical Power, is an inflexible Right Line, made use of to raise Weights, either weighing nothing it self, or of such Weight as may be balanced. The Lever is threefold.



1. Sometimes the Fulcrum is placed between the Weight and the Power.
2. Sometimes the Weight is between the Fulcrum and the Power.
3. And often also the Power acts between the Weight and the Fulcrum F.



If FM be a Lever, and the Weight P hangs any where thereon, and FR be the Horizon, then the Power M that will keep the Weight P at any Elevation, MFR , acting in the Direction SM , perpendicular to FM , in which Direction the Action of the

LI

Power is a Maximum, will be to the Weight P , as FN to FM . For it is as FR to FM , that is, FN to FP ; and as FP to FM , that is, as $FN \times FP$: $FM \times FP$. And since FP is in both : therefore as FN : FM .

The Action of a Power P , and the Resistance of the Weight M , encrease in proportion to their Distance from the Fulcrum ; and therefore that a Power may be able to sustain a Weight, it is required, that the Distance of the Point in the Lever to which it is applied, be to the Distance of the Weight, as the Weight to the Intensity of the Power ; which, if it be ever so little increased, will raise the Weight.

LEVITY, is the Diminution or Want of Weight in any Body, when compared with another that is heavier ; and in this Sense is opposed to Gravity.

LIBRA, one of the twelve Signs of the Zodiac, being exactly opposite to *Aries*.

LIBRATION of the Moon, (see *Evection*) is of three Kinds.

1. Her *Libration* in Longitude ; which is a Motion arising from the Plane of that Meridian of the Moon, (which is always, nearly, turned towards us,) being directed not to the Earth, but towards the other Focus of the Moon's Elliptical Orbit ; and so to an Eye on the Earth she seems to Librate to. And again in Longitude, or according to the Order of the Signs in the Zodiac, this Libration is of no Quantity twice in each Periodical Month, viz. when the Moon is in her *Apogaeum*, and in her *Perigaeum* ; for the Plane of her Meridian above mention'd, is directed alike to both the Foci.

2. Her

2. Her Libration in Latitude; which arises from hence, That her Axis not being perpendicular to the Plane of her Orbit, but inclined to it, sometimes one of her Poles, and sometimes the other, will nod (as they call it) or dip a little towards the Earth, (as is the Case of the Poles of the Earth towards the Sun;) and consequently she will appear to Librate a little, and to shew sometimes more of her Spots, and sometimes less of them, towards each Pole; which Libration depending on the Position of the Moon, in respect of the Nodes of her Orbit with the Ecliptick, (and her Axis being perpendicular nearly to the Plane of the Ecliptick) is very properly said to be in Latitude.

3. And this is compleated in the Space of the Moon's Periodical Month, or rather, while the Moon is returning again to the same Position, in respect of her Nodes.

4. There is also a third kind of Libration; by which it happens, that though another Part of her is not really obverted to the Earth, as in the former Libration, yet another is illuminated by the Sun: For since her Axis is perpendicular nearly to the Plane of the Ecliptick, when the Moon is most Southerly, in respect of the Ecliptick North-Pole, some Parts nearly adjacent to it will be illuminated by the Sun; while, on the contrary, the South-Pole will be in Darkness. In this Case therefore, if it happens that the Sun be in the same Line with the Moon's Southern Limit, then will she, as she proceeds from Conjunction with the Sun towards her ascend-

ing Node, appear to dip her Northern Polar Parts a little into the dark Hemisphere, and to raise her Southern Polar Parts as much into the Light. And the contrary to this will happen the next Fortnight, while the New Moon is descending from her Northern Limit; for then her Northern Polar Parts will appear to Emerge out of Darkness, and the Southern Polar Parts to dip into it: And this seeming Libration, or rather these Effects of the former Libration in Latitude, depending upon the Light of the Sun, will be compleated in her Synodical Month. *Greg. Astron. Lib. 4. Sect. 10.*

LIFTING PIECES, are Parts of a Clock which do lift up and unlock the Detents in the Clock-part.

LIGHT, is Fire entring our Eyes in straight Lines; and by the Motion thereof that it communicates to the Fibres in the bottom of the Eye, it excites the Idea of Light.

1. A rectilinear Motion is the Motion of Light, as it appears from its being easily stopped by an Obstacle.

2. And that an irregular Motion is more proper for it, may be proved, because the Rays that come directly from the Sun to the top of a Mountain, produces no Heat; whilst in the Valley, where the Rays are agitated with an irregular Motion by several Reflexions, there is often produced a very intense Heat.

3. That there is Light where there is not Fire, is beyond all doubt; for we daily see hot Bodies that do not shine.

4. As to the Motion of Light,
it

it is plain, that it is performed in Right Lines; but whether it be Successive or Instantaneous, is disputed; that is, whether at the same Moment that a Body begins to shine, the Light is sensible at any Distance; or whether the Light goes on successively to Places more and more distant.

5. It seems clear to follow from several Astronomical Observations, that that Motion is successive, and Philosophers did not long doubt of it; but by some later Observations, the Conclusions drawn from the former are weakened, and we are obliged to confess that the Motion of Light has something unknown to us.

6. The Presence of the Air is often necessary for the Production of Light.

7. 'Tis probable, that the Rays of Light which fall upon Bodies, and by that means are reflected or refracted, begin to bend before they arrive at the Bodies; and that Light is reflected, refracted, and inflected by one and the same Principle, acting variously in various Circumstances.

8. 'Tis probable also, that Bodies and Light act on each other: Bodies in emitting, reflecting, refracting, and inflecting it; and Light, by heating them, and putting their Parts into a vibrating Motion, wherein Heat consists.

9. All fixed Bodies, when heated beyond a certain Degree, do emit Light and Shine; and this Shining and Emission of Light is probably caused by the vibrating Motions of the Parts; and all Bodies abounding with earthy Particles, and especially when they are sulphureous, when their

Parts are sufficiently agitated, do emit Light; whether this Agitation be caused by Attrition, by Percussion, by Putrefaction, or a vital Motion in an Animal Body, &c. or any other way. Thus the Sea-water shines in a Storm; Quicksilver when shaken in *vacuo*; a Cat's Back or a Horse's Neck rubbed by the Hand in the Dark; Wood, Flesh and Fish when Putrefied.

10. Every visible Point of any Object emits Rays of Light into all Parts, from whence that Point is visible.

Sir Isaac Newton, in his Opticks, proposes the following Queries.

1. Do not great Bodies conserve their Heat the longest, their Parts heating one another? and may not great Dense and Fixed Bodies, when heated beyond a certain Degree, emit Light so copiously, as by the Emission and Reaction of its Light, and the Reflexions and Refractions of its Rays within its Pores to grow still hotter, till it comes to a certain Period of Heat, such as is that of the Sun? And are not the Sun and fixed Stars, great Earths vehemently Hot, whose Heat is conserved by the Greatness of the Bodies, and the mutual Action and Reaction between them, and the Light which they emit, and whose Parts are kept from fuming away, not only by their Fixity, but also by the vast Weight and Density of the Atmospheres incumbent upon them, and very strongly compressing them, and condensing the Vapours and Exhalations which arise from them? For if Water be made warm in any pellucid

pellucid Vessel emptied of Air, that Water in the *Vacuum* will bubble and boil as vehemently as it would in the open Air in a Vessel set upon the Fire, till it conceives a much greater Heat. For the weight of the incumbent Atmosphere keeps down the Vapours, and hinders the Water from boiling, until it grows much hotter than is requisite to make it boil in *Vacuo*. Also a Mixture of Tin and Lead being put upon a red hot Iron in *Vacuo*, emits a Fume and Flame; but the same Mixture in the open Air, by reason of the incumbent Atmosphere, does not so much as emit any Fume which can be perceived by Sight. In like manner the great Weight of the Atmosphere, which lies upon the Globe of the Sun, may hinder Bodies there from rising up, and going away from the Sun in the form of Vapours and Fumes, unless by means of a far greater Heat than that which on the Surface of our Earth would very easily turn them into Vapours and Fumes. And the same great Weight may condense those Vapours and Exhalations as soon as they shall at any time begin to ascend from the Sun, and make them presently fall back again into him, and by that Action increase his Heat much after the manner that in our Earth the Air increases the Heat of a Culinary Fire. And the same Weight may hinder the Globe of the Sun from being diminished, unless by the Emission of Light, and a very small quantity of Vapours and Exhalations.

2. Do not several sorts of Rays make Vibrations of several Bignesses, which according to

their Bignesses, excite Sensations of several Colours, much after the same manner that the Vibrations of the Air, according to their several Bignesses, excite Sensations of several Sounds? And particularly, do not the most refrangible Rays excite the shortest Vibrations for making a Sensation of deep Violet, the least refrangible, the largest for making a Sensation of a deep Red, and the several intermediate sorts of Rays, Vibrations of several intermediate Bignesses to make Sensations of the several intermediate Colours?

3. May not the Harmony and Discord of Colours arise from the Proportions of the Vibrations propagated through the Fibres of the Optick Nerves into the Brain, as the Harmony and Discord of Sounds arise from the Proportions of the Vibrations of the Air? For some Colours, if they be viewed together, are agreeable to one another, as those of Gold and Indigo, and others disagree.

LIKE QUANTITIES, in *Algebra*, are such as are expressed by the same Letters equally repeated in each Quantity. Thus $5b$ and $4b$, and $10ff$ and $2ff$, are like Quantities; $5b$, and $4bb$, and $10ff$, and $2fff$, are unlike ones; because the Quantities have not every where the same Dimensions, nor are the Letters equally repeated.

LIKE SIGNS, in *Algebra*, are when both are Affirmative, or both Negative; but if one be Affirmative, and the other Negative, they are Unlike Signs. Thus $+30d$, and $+2d$, have Like Signs, but $-3ff$, and $+ff$, have Unlike Signs.

LIKE

L I

LIKE FIGURES, in Geometry, are such as have their Angles equal, and the Sides about these equal Angles proportional.

LIKE FIGURES, are in the duplicate *Ratio* of their Homologous Sides.

LIKE ARCHES of a Circle, are such as contain an equal Number of Degrees.

LIKE SOLID FIGURES, in Geometry, are such as are contained under like Planes, equal in Number.

LIKE SOLID FIGURES, are to one another in the duplicate *Ratio* of their Homologous Sides.

LIMB, signifies the outermost Border or graduated Edge of an Astrolabe, Quadrant, or the like Mathematical Instrument; or the Circumference of the Primitive Arch in any Projection of the Sphere in *Plano*: Also the outermost Border of the Sun's or Moon's Disk, in an Eclipse of either Luminary.

LIMBERS, in *Gunnery*, are a kind of Train joined to the Carriage of a Cannon upon a March; it is composed of two Shafts, wide enough to receive a Horse between them (which Horse is called the Fillet-Horse.) These Shafts are joined by two Bars of Wood, and a Bolt of Iron at the End, and have a Pair of small Wheels. On the Axel-Tree rises a strong Iron Spike, on which the Train of the Carriage is put upon a March: But when a Gun is on Action, these *Limbers* are run out behind her.

LIMIT of a Planet, is the greatest Heliocentrick Latitude. Which see.

LIMITED PROBLEM, signifies a Problem that hath but one, or a determined Number

L I

of Solutions; as to make a Circle pass thro' three Points given, not lying in a Right Line, to describe an Equilateral Triangle on a Line given, &c.

LINCH-PINS, are those Pins that keep on the Carriage of a Piece of Ordnance.

LINE, a *Line in Geometry*, is a Quantity extended in Length only, and is supposed to have no Breadth or Thickness. It is made by the Motion of a Point.

LINE is also the 12th Part of an Inch.

LINE of True Place } of a Planet is a right
Apparent }

LINE { Earth's Centre } thro'
drawn { Eye of the } the
from { Spectuor }

Planet, and continued as far as the fixed Stars.

LINE of Measures, in the Stereographick Projection of the Sphere in *Plano*, is that Line in which the Plane of a great Circle perpendicular to the Plane of the Projection, and that oblique Circle which is projected, intersects the Plane of the Projection: Or it is the common Section of a Plane passing thro' the Eye's Point, and thro' the Centre of the Primitive, and at Right Angles to any oblique Circle which is to be projected, and in which the Centre and Pole of such a Circle will be found.

LINE of Direction of the Earth's Axis, in the Pythagorean System of Astronomy, is the Line connecting the two Poles of the Ecliptick, and of the Equator, when they are projected on the Plane of the former.

LINE of the Section, in Perspective, is the Intersection or contact of the plain to be projected

jected with the Glass or Diaphanous Plane.

LINE of Lines, on the Sector, is a Scale of equal Parts on each Leg, and running from the Centre. This is divided into 100 equal Parts, and sometimes into more, when the Instrument is large.

LINE of Numbers. See *Gun-ter's Line*.

LINE, in *Fortification*, is that which is drawn from one Point to another, in delineating a Plane upon Paper: But in the Field it is sometimes taken for a Ditch bounded with its Parapet, and sometimes for a Row of Gabions, or Sacks of Earth, extended in length on the Ground, to serve as a Shelter against the Enemy's Fire. Thus they say, when the Trenches were carried on within 30 Paces of the Glacis, We drew two Lines, one on the Right Hand, and the other on the Left, for a Place of Arms.

LINE CAPITAL, is that which is drawn from the Angle of the Gorge to the Angle of the Bastion.

LINE CENTRAL, is that which is drawn from the Angle of the Centre, to that of the Bastion.

LINE of Defence, is that which represents the Course of the Bullet of any sort of Fire-Arms, more especially of a Musquet-Ball, according to the Situation which it ought to have to defend the Face of the Bastions.

LINE of Defence Fixed or Fichant, is that which is drawn from the Angle of the Curtain, to the flanked Angles of the opposite Bastion; nevertheless without touching the Face of the Bastion. This must never exceed 800 Feet, which they reckon the Di-

stance a Musquet-Ball will do Execution.

LINE of Defence Razant, is that which being drawn from a certain Point of its Curtain, raiseth the Face of the opposite Bastion. This is called also the Line of Defence Stringent or Flanking.

LINE of Approach, or of Attack, signifies the Work which the Besiegers carry on under Covert, to gain the Moat, and the Body of the Place.

LINE of Circumvallation, is a Line or Trench cut by the Besiegers within Cannon-Shot of the Place, which rangeth round their Camp, and secures its Quarters against the Relief of the Besieged.

LINE of Contravallation, is a Ditch bordered with a Parapet, which serves to cover the Besiegers on the Side of the Place, and to stop the Salleys of the Garrison.

LINEs within side, are the Moats towards the Place, to prevent the like Salleys.

LINEs without side, are the Moats towards the Field, to hinder Relief.

LINEs of Communication, are those that run from one Work to another. But the Line of Communication, more especially so called, is a continued Trench, with which a Circumvallation or Contravallation is surrounded, and which maintains a Communication with all its Forts, Redoubts, and Terables.

LINE of the Base, is a Right Line which joins the Points of the two nearest Bastions.

To **Line** a Work, is to strengthen a Rampart with a firm Wall, or to encompass a Parapet or Moat with a good Turff, &c.

LINE A

LINEA APSIDUM, or the *Line of the Apes*, in the old Astronomy, is a Line passing through the Center of the World, and of the Excentrick; and whose two Ends are, one the *Apogæum*, the other the *Perigæum* of the Planet. That part of this Line which lies between the Center of the World and that of the Excentrick, is called the Excentricity.

LINE of Greatest or Least Longitude of a Planet, is that Part of the *Linea Apfidum* reaching from the Center of the World to the *Apogæum* or *Perigæum* of the Planet.

LINE of Mean Longitude, is one drawn through the Center of the World at Right Angles to the *Linea Apfidum*, and is there a new Diameter of the Excentrick or Different; and its extream Points are called the Mean Longitude.

LINE of the Mean Motion of the Sun, in the old Astronomy, is a Right Line drawn from the Center of the World as far as to the *Zodiack* of the *Primum Mobile*; and parallel to a Right Line drawn from the Center of the Excentrick, to the Center of the Sun; which latter Line they call also the Line of the Mean Motion of the Sun in the Excentrick, to distinguish it from the former; which is the Line of Mean Motion in the *Zodiack* of the *Primum Mobile*.

LINE of the Sun's True Motion, is a Line drawn from the Center of the World to the Center of the Sun, and produced as far as the *Zodiack* of the *Primum Mobile*.

LINE HORIZONTAL, is a Right Line parallel to the Horizon.

1. In Dialling, it is the common Section of the Horizon and the Dial-Plane.

2. In Perspective, it is the

common Section of the Horizontal Plane, and that of the Draught or Representation, and which passes thro' the principal Point.

LINE GEOMETRICAL, in Perspective, is a Right Line drawn any how on the Geometrical Plane.

LINE TERRESTRIAL, in Perspective, is a Right Line, where in the Geometrical Plane and that of the Picture or Draught intersect one another.

LINE of the Front, in Perspective, is the common Section of the Vertical Plane, and of the Draught.

LINE of Station, in Perspective, according to some Writers, is the common Section of the Vertical and Geometrical Planes. Others, as *Lamy*, mean by it the Perpendicular Height of the Eye above the Geometrical Plane. Others, a Line on that Plane, and perpendicular to the Line expressing the Height of the Eye.

LINE OBJECTIVE, in Perspective, is the Line of an Object, from whence the Appearance is sought for in the Draught or Picture.

LINE of Gravitation of any heavy Body, is a Line drawn through its Center of Gravity, and according to which it tends downwards.

LINE of Direction, of any Body in Motion, is that according to which it moves, or which directs and determines its Motion.

LINE of the swiftest Descent of a heavy Body, is the Cycloid.

LINE of the Anomaly of a Planet, in the *Ptolemaick* System, is a Right Line drawn from the Center of the Excentrick to the Center of the Planet.

LINE of the Apogæum of a Planet, in

in the Old Astronomy, is a Right Line drawn from the Centre of the World, through the Point of the *Apogæum*, as far as the *Zodiack* of the *Primum Mobile*.

LINE of the Nodes of a Planet, in the New Astronomy, is a Right Line drawn from the Planet to the Sun, being the common Interfection of the Plane of the Planet's Orbit with that of the *Ecliptick*.

LINE EQUINOCTIAL, in Dialling, is the common Interfection of the Equinoctial, and the Plane of the Dial.

LINED MOAT, a Term in Fortification. See *Moat*.

LINEAR NUMBERS, are such as have relation to Length only; as (*v gr.*) such as represent one Side of a plain Figure; and if the plain Figure be a Square, the *Linear Number* is called a *Root*.

LINEAR PROBLEM, in Mathematicks, is such an one as can be solved Geometrically by the Interfection of two Right Lines. This is called a *Simple Problem*, and is capable but of one Solution.

LINE SUBSTYLAR, is that Line on which the Style or Cock of a Dial is erected, and is the Representation of such an Hour-Circle as is perpendicular to the Plan of that Dial

LINE SYNODICAL, in reference to some Theories of the Moon, is a Right Line supposed to be drawn through the Centres of the Earth and the Sun; and if it be produced quite through the Orbits, 'tis called the

LINE of the True Syzygies: But a Right Line imagined to pass through the Earth's Centre, and the Mean Place of the Sun is called the

LINE of the Mean Syzygies.

LINES of Chords, Sines, Tangents, Secants, Versed Sines, &c. See *Scale*.

LINSTOCK, is a short Staff of Wood about three Foot long, having at one End a Piece of Iron divided into two Branches, each of which hath a Notch to hold a Piece of Match, and a Screw to fasten it there. The other End of the Staff is shod also with Iron, and pointed to stick into the Ground; 'tis used by the Gunners in firing Cannon.

LIQUIDS, are such Bodies as have all the Properties of Fluidity, (see that Word;) and withal, have their Particles so formed, figured, or disposed, that they do adhere to the Surfaces of such Bodies as are immersed in them, which we call *Wetting*; and this Property of Liquid Bodies is sometimes called *Humidity* or *Moisture*.

LIST, in Architecture, is a little square Moulding, serving to crown or accompany a larger, or on Occasion to separate the Flutings of a Column. It is sometimes called *Fillet*, and sometimes *Square*.

LISTEL, a small Band, or a kind of a Rule in the Mouldings of Architecture: Also the Space between the Channellings of Pillars.

LITERAL, in Algebra. See *Algebra*.

LIZIERE, a Term in Fortification, is the same with *Berm*. Which see.

LOCAL PROBLEM, in Mathematicks, is such an one as is capable of an infinite Number of different Solutions: So that the Point which is to resolve the Problem, may be indifferently taken

one of its Points M parallel to BE , the similar Triangles ABE , APM , will give always this Proportion, viz. $AB (a) : BE (b) ::$

$$AP (x) : PM (y) = \frac{bx}{a}. \text{ And}$$

therefore the Right Line AE is the Locus of all the Points M .

Moreover, (Fig. 2.) if $yy = aa - xx$ expresses the Relation of AP to PM , and the Angle APM be a Right Angle, then the Circumference of a Circle, whose Radius is the Right Line $AB = a$ taken in AP , is called in general a *Geometrick Locus*, and, in particular, the Locus of the Equation $yy = aa - xx$. For if the Perpendicular $MP (y)$ be drawn from any Point M of the Circumference, then by the Nature of the Circle, we shall have always $PM^2 (yy) = DP \times PB (aa - xx)$, supposing BD the Diameter of the Circle. Therefore the Locus of all the Points M is the Circumference of a Circle.

3. If all the PM 's be supposed to tend from one Side of Line AB , as towards Q ; and then they be supposed to tend from the other Side of the said Line, as towards G ; then it must be observed, that their Values from Positives (which they are supposed to be when tending towards Q ;) will become Negative, and so shall we have $PM = -y$. Moreover, if the Point P be supposed to fall from A towards B , and afterwards the contrary Way, as from A towards D ; then all the AP 's on this Side A will become Negative, and consequently we have $AP = -x$. And a Geometrick Locus must pass through the Extremities of all the Values (as well positive as negative) of

one of the unknown Quantities y , which answer to the Values both Positive and Negative of the other unknown Quantity x . Therefore, if the Right Line QAG be drawn parallel to PM , a Geometrick Locus may be found in the four Angles BAQ , BAG , GAD , DAQ , as in the second Example, (Fig. 2.) or only in some of the Angles, as in the first Case, (Fig. 1.) For in the second Example, suppose that $AP = x$, and $PM = y$, the Point M being taken afterwards in the Quadrant QB ; then if the Point M be taken afterwards in the Quadrant GB , we shall have $AP = -x$, and $PM = -y$; if M be taken on DG , we shall have $AP = -x$, and $PM = -y$; And finally, if M be taken on DQ , we shall have $AP = -x$, and $PM = y$. And in all these Cases (by the Nature of the Circle) there will come out the same Equation $yy = aa - xx$; because the Squares of $+y$, and $-y$, are the same in all Cases, viz. yy and xx . Moreover, in the first Example, if you make $AP = x$, and $PM = y$, in the first taken Point M taken (on the same Side as E) upon AE (produced towards A) in the Angle GAD , we shall have $AP = -x$, and $PM = -y$; and since the Triangles ABE , APM , are similar, the following Proportion will be formed, viz. $AB (a) : BE (b) :: AP (-x) : PM (-y) = -\frac{bx}{a}$, and there-

fore $y = \frac{bx}{a}$. Which is the same Equation as was formed, by supposing the Point M to fall in the Angle BAQ .

4. The antient Geometricians did call *Plain Loci*, such that are Right Lines or Circles; and *Solid Loci*, those that are Parabola's, Ellipses, or Hyperbola's; and *Surd-Solid Loci*, such that are Curves of a superiour Gender than Conick Sections. But the Moderns do distinguish *Geometrick Loci* into different Kinds or Degrees. For under the first Degree are comprehended all the Loci, wherein the unknown Quantities x and y are found in Equations only of one Dimension; under the second, all those wherein those unknown Quantities have two Dimensions, and so on; where you may observe, that there must be no Rectangle or Product of the unknown Quantities x and y in the Equations for the Loci of the first Kind or Degree; and in the Equations for the second, those Quantities must form a Product, as xy of no more than two Dimensions; and in Equations for the third, a Product xx , or yy , of three Dimensions, &c.

5. The Terms of the Equation of a Locus are said to be different, when either of the unknown Quantities x and y , or both of them together, are found therein of different Dimensions: So in the first Degree, if this Equation be proposed, $y - \frac{bx}{a} + c = 0$, the Terms

y , $-\frac{bx}{a}$, c will be different.

Moreover, in the second Degree, if you suppose $yy + \frac{2bxy}{a}$

$- 2cy - \frac{fxx}{a} + gx + bx - bb$

$+ 11 = 0$; then the Terms yy , $\frac{2bxy}{a}$, $- 2cy$, $-\frac{fxx}{a}$, gx , $+bx$, $-bb + 11$, shall be every one of them different.

6. When the unknown Quantities x and y , have but one Dimension in a given Equation, and their Product xy is not in the same, then the Locus of that Equation will be always a straight Line; and it may be reduced to some one of the four following Formula's, 1. $y = \frac{bx}{a}$.

2. $y = \frac{bx}{a} + c$. 3. $y = \frac{bx}{a} - c$.

4. $y = c - \frac{bx}{a}$.

6. When any Equation of two Dimensions is given, and it is required to know which of the Conick Sections will be the Locus of it.

Bring over all the Terms of the Equation to one Side; so that one Member thereof be 0, then there may happen two Cases:

Case 1. When the Plane xy is not in the given Equation.

1. If there be but one of the Squares yy or xx therein, then the Locus will be a Parabola.

2. If both the Squares yy and xx are found therein with different Signs, then the Locus will be an Ellipsis or a Circle. 3. If the said two Squares are found therein with different Signs, then the Locus thereof will be an Hyperbola, or the opposite Sections regarding their Diameters.

Case 2. When the Plane xy happens to be in a given Equation. 1. If neither of the Squares yy and xx , or but one of them,

are

are found in the Equation, then the Locus will be an Hyperbola between its Asymptotes. 2. If the Squares yy and xx are found therein with different Signs, then the Locus shall be an Hyperbola regarding its Diameters. 3. If the said two Squares have the same Signs, the Square yy must be freed from Fractions, and then the Locus shall be a Parabola, when the Square of half the Fraction multiplying xy be equal to the Fraction multiplying xx . An Ellipsis, or Circle, when the same is less; and finally, an Hyperbola, or two opposite ones, regarding their Diameters, when the same is greater.

LOCUS AD LINEAM, is when the Point that satisfies the Problem, is found in a Line, whether Right or Curve, and that by reason of the Want of one Condition, only to render the Problem determinate altogether.

LOCUS AD SOLIDUM, is when three Conditions are wanting to the Determination of the Point sought, and so it will be found in a Solid; and this may be included either under a Plane, Curve, or mix'd Superficies, and those either determinate, or indefinitely extended.

LOCUS AD SUPERFICIEM, is when there being two Conditions wanting to determine any Point that satisfies any Problem, that Point may be taken throughout the Extension of some Superficies, whether Plane or Curve.

LODGMET of an Attack, is a Work cast up by the Besiegers, during their Approaches in a dangerous Post, where it is absolutely necessary to secure themselves against the Enemy's Fire;

as in a Cover'd-Way, in a Breach, in the Bottom of a Moat, or elsewhere. This Lodgment consists of all the Materials that are capable to make Resistance, viz. Barrels and Gabions of Earth, Palisadoes, Woolpacks, Mantelets, Faggots, &c.

LOG-LINE, is one to which the Log is fasten'd to, which is wound about a Reel for that Purpose, fixed in the Gallery of the Ship. This Line, for about 10 Fathom from the Log, hath, or ought to have, no Knots or Divisions; because so much should be allowed for the Log's being clear out of the Eddy of the Ship's-Wake before they turn up the Glass; but then the Knots or Divisions begin, and ought to be at least 50 Foot from one another; tho' the common erroneous Practice at Sea is to have them but seven Fathom, or 42 Foot distance.

Tho' this at best be but a precarious Way, 'tis however the most exact of any in Use, and much better than that of the Spaniards and Portuguese, who guess at the Ship's Way by the running of the Froth or Water by the Ship's Side; or than that of the Dutch, who use to heave over a Chip into the Sea, and so to number how many Paces they can walk on the Deck, while the Chip swims or passes between any two Marks or Bolt-Heads on the Side.

LOGARITHMS, are the Indexes of the Ratio's of Numbers one to another; or they are a Series of artificial Numbers (invented for the Ease and Expedition of Calculation) proceeding in Arithmetical Proportion, as the Numbers, they answer to, do

in a Geometrical one. As for Example,

1. 2. 4. 8. 16. 32. 64. 128. 256. are Numbers proceeding from Unity in a Geometrical Proportion continued. Now, if over these you place a Series of Numbers, beginning with 0 in an Arithmetical Progression they will stand thus :

0. 1. 2. 3. 4. 5. 6. 7. 8. 9. 10.

1. 2. 4. 8. 16. 32. 64. 128. 256. 512.

And the Numbers above beginning with 0, are called the *Logarithms* of those in a Geometrical Progression answering to them. Or,

LOGARITHMS, are Numbers in Arithmetical Progression, so fitted to the Natural Numbers, that if any two Natural Numbers are multiply'd, or divided by one another, the Logarithms of those Natural Numbers, that is, if those answering them be added to, or subtracted from each other the Sum or Remainder, will be the Logarithm of the Product, or the Quotient of those two Natural Numbers.

LOGARITHM $\left\{ \begin{array}{l} \text{Sine,} \\ \text{Tangent,} \\ \text{Secant,} \end{array} \right\}$ of an Arch, is the Logarithm of the Natural Sine, Tangent, and Secant.

1. If the Difference between Unity, and any Number greater, be called y ; then the Logarithm

of the Number $1+y=y-\frac{1}{2}y^2+\frac{1}{3}y^3-\frac{1}{2}y^4+\frac{1}{5}y^5$, &c. And if

y be a Number less than Unity; then will the Logarithm of $1-y$, a Number less than Unity, be $=-y-\frac{1}{2}y^2-\frac{1}{3}y^3-\frac{1}{4}y^4-\frac{1}{5}y^5$, &c.

$\frac{1}{5}y^5$, &c.

2. But these Logarithms are different from those of *Brigg's Form*, which are commonly used; yet one of these Logarithms, is to that of *Brigg's*, as 2.302585092994 to 1.000000000000.

3. If the Radius be 1, and the Cosine of any Arch x ; then the Sine will be $\sqrt{1-xx}$; then

the Logarithm of $1+x=x-\frac{1}{2}$

$x+\frac{1}{3}x^3-\frac{1}{4}x^4-\frac{1}{5}x^5-\frac{1}{6}x^6$, &c. And the Logarithm of

$1-x=-x-\frac{1}{2}x-\frac{1}{3}x^3-\frac{1}{5}x^5-\frac{1}{6}x^6$, &c. And the Logarithm of

$\sqrt{1-xx}=\frac{1}{2}x^2-\frac{1}{4}x^4-\frac{1}{6}x^6$.

4. If the Radius or Tangent of 45 Degrees be 1, the Tangent of an Arch greater than 45° = $1+x$, and 0 one less = $1-x$; then the Logarithm of the Tangent in the former Case will be

$x-\frac{1}{2}x^2+\frac{1}{3}x^3-\frac{1}{4}x^4+\frac{1}{5}x^5$, &c. And in the latter $-x-\frac{1}{2}x^2$

$-\frac{1}{3}x^3-\frac{1}{4}x^4-\frac{1}{5}x^5$, &c.

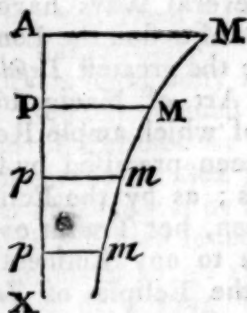
LOGARITHMICK CURVE. If the Right Line AX be divided into any Number of equal Parts, and if in the Points of Division A, P, p , &c. be joined the Right Lines AN, PM, pm , &c. continually proportional; the Points N, M, m , &c. will be in the Curve called the *Logarithmick Curve*.

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1. The Abscissa's $AP, Ap, \&c.$ are the Logarithms of the Semi-Ordinates $PM, pm, \&c.$

2. Whence if $AP=x, AP=v, PM=y, pm=z$, and the Logarithms of y and $z=ly$, and lz ;



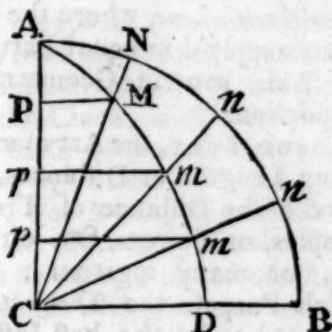
then $x=ly$, and $v=lz$: and so $x:v::ly:lz$, that is, the Denominators of the Ratio's of AN to PM , and AN to pm , are to one another as the Abscissa's AP, Ap .

3. Whence there may be supposed infinite Kinds of Logarithmick Curves, if $x^m:v^m::ly:lz$, since the Semi-Ordinates pm continually decrease, while the Ratio of AN to pm continually increases with the Abscissa, the Curve continually accedes to the Axis AX ; but will never meet it, and so AX is an Asymptote to the Curve.

LOGARITHMICK SPIRAL. If the Quadrant of a Circle ANB be divided into any Number of equal Parts in the Points $P, p, p, \&c.$ and from the Radii $CP, Cp, Cp, \&c.$ be cut off $CM, Cm, Cm, \&c.$ continual Proportionals, the Points $M, m, m, \&c.$ will be in the Logarithmick Spiral. Whence the Arches $AP,$

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$Ap, \&c.$ are the Logarithms of the Ordinates $CM, Cm, \&c.$ and there may be imagined an infi-



nite Number of different Curves of this Kind.

LOGISTICAL ARITHMETICK, was formerly the Arithmetick of Sexagesimal Fractions, and used by Astronomers in their Calculations. I suppose it was so called from a Greek Treatise of one *Barlaamus Monettas*, who wrought about Sexagesimal Multiplication very accurately, and entitled his Book *Logisticé*. This Author *Vossius*, in his Book *De Scientiis Mathematicis*, places about the Year 1350, but mistakes it for a Treatise of *Algebra*.

Thus also *Shakerly*, in *Tabula Britannica*, hath a Table of Logarithms adapted to Sexagesimal Fraction, which therefore he calls *Logistical Logarithms*; and the expeditious Arithmetick of them, which is by this Means obtained, and by which all the Trouble of Multiplication and Division is saved, he calls *Logistical Arithmetick*. Though some, by

LOGISTICKS, will understand the first General Rules in *Algebra*, of Addition, Subtraction, &c.

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LOGISTICK SPIRAL. See *Logarithmick Spiral*.

LOGISTICAL LINE, is that which is otherwise called the *Logarithmick Line*, where the Ordinates apply'd in equal Parts of the Axis are in Geometrical Proportion.

LONGIMETRY, the Art of measuring Lengths or Distances, or to take the Distance of Trees, Steeples, or Towers, &c. either one, or many together; for which Purpose the *Theodolite* is reckoned to be the best Instrument.

LONGITUDE of a Place, is an Arch of the Equator intercepted between the Meridian of that Place, and the first Meridian; or 'tis more truly the Difference, either East or West, between the Meridians of any two Places, counted on the Equator.

LONGITUDE in the Heavens, is an Arch of the Ecliptick, counted from the Beginning of *Aries*, to the Place where the Star's Circle of Longitude crosses the Ecliptick; so that 'tis much the same as the Star's Place in the Ecliptick, reckoned from the Beginning of *Aries*.

LONGITUDE of the Sun or Star from the next Equinoctial Point, is the Number of Degrees and Minutes, they are from the Beginning of *Aries* or *Libra*, either before or after them, which can never be more than 180 Degrees.

LONGITUDE, in Dialling. The Arch of the Equinoctial, intercepted between the Subtilar Line of the Dial and the true Meridian, is called the *Plane's Difference of Longitude*.

LONGITUDE, in Navigation,

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is also the Distance of a Ship or Place, East or West from another, (counted in proper Degrees;) but if in Leagues or Miles, or Degrees of the Meridian, and not in those proper to the Parallel of Latitude, it is commonly called *Departure*.

1. Several Ways have been thought of to find the Longitude at Sea; the greatest *Desideratum* of the Art of Navigation, for doing of which ample Rewards have been promised by several Nations; as by the Eclipse of the Moon, her Transit over, or Appulse to any Eminent fixed Star; the Eclipses of *Jupiter's Satellites*, &c. which are all true in Theory, and may be practised ashore with the greatest Exactness. For the Time of any one of these Phænomena being truly calculated for the Meridian of *London* (suppose, or any other;) and Tables may be easily made of all of them, which the Navigator may carry to Sea with him. If then he could but observe the Time of the Eclipse or Transit at Sea with accurate Exactness, the Difference of Time of the Eclipse happening to him sooner or later than at *London*, would give him the exact Longitude of the Place of the Ship, either East or West from the Meridian of *London*: But the Misfortune is, such an Observation of an Eclipse, and the exact Time of the Impression or Emergence of the deficient Body into, or out of the Shadow, is not to be made without Telescopes of such a Length, as the Motion of the Ship will not permit to be used at Sea: Tho' by the by, if Ships were sent with good Instruments,

struments, and Men that know how to use them, to do this at all the Capes and Head-Lands of the World, it would be a Thing of the greatest Use; and by settling the Longitude of all those Places, would cut all long Voyages into many short ones, and afford Means of continually rectifying the Dead Reckoning at Sea. But to return:

2. Others being fully satisfied of the Impracticableness of the Method of Eclipses for finding the Longitude at Sea; have thought of Doing it by a Clock or Watch: Which indeed, if it could be made to go right all the Time of a long Voyage, would give the Longitude at any Time, when the true Hour of the Day or Night could be had under any Meridian, or in any Place of the Earth: For the Clock going true for the Meridian it was first set at, will shew the true Hour of the Day or Night under any Meridian, or in any Place of the Earth: For the Clock going true for the Meridian it was first set at, will shew the true Hour exactly in that Place; and then the true Hour being found by the Sun or Stars in the Place where the Ship is, the Difference between that and the Clock's Hour will be the Difference of the Meridian in Time, or Longitude in Degrees.

3. But no such Movement hath ever yet been made, and, I fear, scarce ever will, which will keep going, and going true in all Climates, and especially in some of the Southern ones, where the Dews are so great as to rust the Parts of it, and so

retard, if not stop its Motion entirely. I don't mention the Inconvenience arising from the Motion of the Ship, because I believe that may be obviated.

4. And there is another greater one than all the rest: For in different Latitudes the Hours shown by the Clock, must be different for those wherein it is fitted, to shew the Time.

5. For Example, a Clock fitted to shew the Time at *Paris*, if it be carry'd under the Equinoctial, will go three or four Minutes slower than at *Paris*.

6. And the Law of the Retardation of the Clock's Motion, as you go towards the Equator is not well known, therefore it is not safe to trust to the finding the Longitude by automatical Movements.

LOWER FLANK, or RETIRED FLANK. See *Flank*, a Term in Fortification.

LOXODROMIQUES, is the Art or Way of oblique Sailing by the Rhumb, which always makes an equal Angle with every Meridian, *i. e.* when you sail neither directly under the Equator, nor under one and the same Meridian, but obliquely or a-cross them. Hence the Table of Rhumbs, or the Traverse-Table of Miles, with the Difference of Longitudes and Latitudes, by which the Sailor may practically find his Course, Distance, Latitude, or Longitude, is by some called by this Name of *Loxodromiques*; and such Tables as serve truly and expeditiously to find the several Requisites, or to resolve the Cases of Sailing, are called *Loxodromical Tables*.

LUCIDA CORONA, a fixed Star of the second Magnitude, in the

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Northern Garland, whose Longitude is 217 Deg. 38 Min. Latitude 44 Deg. 23 Min. Right Ascension 230 Deg. 12 Min.

LUCIDA HYDRA. See *Cor Hydrae*.

LUCIDA LYRA, a bright Star of the first Magnitude, in the Constellation *Lyra*, whose Longitude is 10 Deg. 43 Min. Latitude 61 Deg. 47 Min. Right Ascension 276 Deg. 27 Min. And Declination 38 Deg. 30 Min.

LUMINARIES. The Sun and Moon are so called by way of Eminence; for their extraordinary Lustre, and the great Proportion of Light that they afford us.

LUNAR CYCLE. See *Cycle of the Moon*.

LUNARY MONTHS, are either Periodical, Synodical, or Illuminative. Which see in their proper Places.

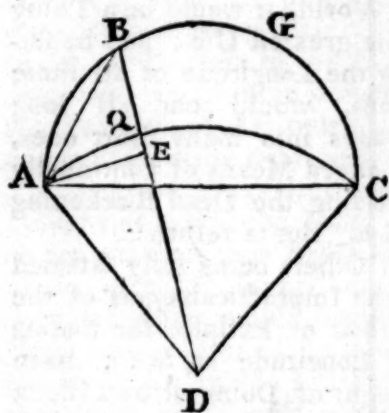
LUNATIONS of the Moon, are the Times between one New Moon and another; and this is greater than the Periodical Month by two Days and five Hours; and is called the *Synodical Month*, consisting of 29 Days, 12 Hours, and three Quarters of an Hour.

LUNES, or LUNULÆ, in Geometry, are Spaces contain'd under a Quadrant of a Circle, and a Semi-Circle; being called thus, because they represent the Figure of the Moon, when less than half full; as the Space *ABGC* is the Lune.

If the Line *AB* is drawn, as also the Line *AE* at Right Angles to *BD*; I say the Triangle *ABE* is equal to the Part *ABQ* of the Lune, and so the

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whole Lune is equal to the Triangle *ADC*.



LUNETTES, in Fortification, are Envelopes, Counter-Guards, or Mounts of Earth cast up before the Curtain, about five Fathom in Breadth, whereof the Parapet takes up three. They are usually made in Ditches full of Water, and serve to the same Purpose as Falsebrayes. These Lunettes are composed of two Faces, which form a re-entring Angle; and their Platform being only twelve Foot wide, is a little raised above the Level of the Water, and hath a Parapet three Fathom thick.

LUPUS, a Southern Constellation, consisting of two Stars.

LYRA, the Harp, a Constellation in the Northern Hemisphere, consisting of 13 Stars.

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MACHINA BOYLIANA, Mr. Boyle's Air-Pump.

MACHINE, or ENGINE, in Mechanics, is whatsoever hath Force

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Force sufficient either to raise or stop the Motion of a Body. These Machines are either Simple or Compound.

Simple Machines are commonly reckoned to be six in Number, viz. the Ballance, Leaver, Pulley, Wheel, Wedge, and Screw. To these might be added the Inclined Plane; since 'tis certain that the heaviest Bodies may be lifted up by the Means thereof, which otherwise could scarce be moved.

Compound Machines or Engines are innumerable, in regard that they may be made out of the Simple, almost after an infinite Manner.

MADRIER, in Fortification, is a thick Plank, armed with Plates of Iron, and having a Concavity sufficient to receive the Mouth of the Petard when charged, with which it is apply'd against a Gate, or any Thing else that you design to break down. This Term is also appropriated to certain flat Beams, which are fixed to the Bottom of a Moat, to support a Wall. There are also Madriers lined with Tin, which are covered with Earth, to serve as a Defence against artificial Fires.

MAGICK SQUARE, is when Numbers in Arithmetick Proportion are disposed into such Parallel and Equal Ranks, as that the Sums of each Row, as well diagonally as laterally, shall be equal.

Thus these nine Numbers, 2, 3, 4, 5, 6, 7, 8, 9, and 10, be-

| | | |
|---|----|---|
| 5 | 10 | 3 |
| 4 | 6 | 8 |
| 9 | 2 | 7 |

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ing disposed into this square Form, they do every Way directly and diagonally make the same Sum. As likewise those 49 Numbers.

| | | | | | | |
|----|----|----|----|----|----|----|
| 30 | 39 | 48 | 1 | 10 | 19 | 28 |
| 38 | 47 | 7 | 9 | 18 | 27 | 29 |
| 46 | 6 | 8 | 17 | 26 | 35 | 37 |
| 5 | 14 | 16 | 25 | 34 | 36 | 45 |
| 13 | 15 | 24 | 33 | 42 | 44 | 4 |
| 21 | 23 | 32 | 41 | 43 | 3 | 12 |
| 22 | 31 | 40 | 49 | 2 | 11 | 20 |

MAGICK LANTHORN, a little Optick Machine, by the Means of which are represented on a Wall, in the Dark, many Phantasms and terrible Apparitions, which are taken for the Effect of Magick, by those that are ignorant of the Secret.

This Machine is composed of a Concave Speculum from one Foot to four Inches Diameter, reflecting the Light of a Candle, which passeth through the little Hole of a Tube, at whose End there is fasten'd another double Convex-Glass of about three Inches Focus, between these two are successively placed many small Glasses, painted with different Figures, of which the most Formidable are always chosen, and such as are most capable of terrifying the Spectators; so that all these Figures may be represented at large on the opposite Wall.

MAGNET, or LOAD-STONE, is a Fossile Approaching to the Nature of Iron-Oar, and endowed with the Property of attracting of Iron, and of both pointing itself, and also enabling a Needle touched upon it, and

and then poised, to point towards the Poles of the World.

MAGNET. *Sturmius*, in his *Epistola Invitatoria Dat. Altros*. 1682, observes, That the attractive Quality of the Magnet hath been taken Notice of beyond all History; but that it was our Countryman *Roger Bacon*, who first discovered the Verticity of it, or its Property of pointing towards the Pole; and this is about 400 Years since. The *Italians* first discovered, that it would communicate this Virtue to Steel or Iron. The various Declination of the Needle, under different Meridians, was first discovered by *Sebastian Cabott*; and its Inclination to the nearer Pole by our Countryman *Robert Noman*. The Variation of the Declination, so that 'tis not always the same in one and the same Place, he observes, was taken Notice of but a few Years before, by *Hewelius*, *Auzout*, *Petit*, *Volckamer*, and others.

The Properties or Phænomena of this wonderful Stone, as they have been discovered by *Gilbert*, *Kircher*, *Cabeus*, *Des Cartes*, and others, are these:

1. That in every Magnet there are two Poles, one pointing North, the other South; and if a Stone be cut or broken into never so many Pieces, there are these two Poles in each Piece.

2. That these Poles in divers Parts of the Globe, are diversely inclined towards the Earth's Centre.

3. That these Poles, tho' contrary to one another, do help mutually toward the Magnet's Attraction and Suspension of Iron.

4. If two Magnets are spherical, one will turn or conform itself to the other, so as either of them would do to the Earth; and that after they have so conformed or turned themselves, they endeavour to approach to join each other; but if placed in a contrary Position, they avoid each other.

5. If a Magnet be cut through the Axis, the Parts or Segments of the Stone, which before were joined, will now avoid and fly each other.

6. If the Magnet be cut by a Section perpendicular to its Axis, the two Points which before were conjoined, will become contrary Poles, one in one, the other in the other Segment.

7. Iron receives Virtue from the Magnet by Application to it, or barely from an Approach near it, though it doth not touch it; and the Iron receives this Virtue variously, according to the Parts of the Stone 'tis made to touch, or made to approach to.

8. If any oblong Piece of Iron be any how apply'd to the Stone, it receives Virtue from it only as to its Length.

9. The Magnet loses none of its own Virtue by communicating any to the Iron, and this Virtue it can communicate to Iron very speedily; though the longer the Iron touches or joins the Stone, the longer will its communicated Virtue hold; and a better Magnet will communicate more of it, and sooner than one not so good.

10. That Steel receives Virtue from the Magnet better than Iron.

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11. A Needle touched by a Magnet, will turn its Ends the same Way towards the Poles of the World, as the Magnet will do.

12. That neither Loadstone nor Needles touched by it, do conform their Poles exactly to those of the World; but have usually some Variation from them; and this Variation is different in divers Places, and at divers Times in the same Place.

13. That a Loadstone will take up much more Iron when armed or capped, than it can alone; and that though an Iron Ring or Key be suspended by the Loadstone, yet the Magnetical Particles do not hinder that Ring or Key from turning round any Way, either to the Right or Left.

14. That the Force of a Loadstone may be variously increased or lessened by the various Application of Iron, or another Loadstone to it.

15. That a strong Magnet, at the least Distance from a lesser or a weaker, cannot draw to it a Piece of Iron adhering actually to such lesser or weaker Stone; but if it come to touch it, it can draw it from the other: But a weaker Magnet, or even a little Piece of Iron, can draw away or separate a Piece of Iron, contiguous to a greater or stronger Loadstone.

16. That in our North Parts of the World, the South Pole of a Loadstone will raise up more Iron than the North Pole.

17. That a Plate of Iron only, but no other Body interposed, can impede the Operation of the Loadstone, either as to its At-

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tractive or Directive Quality, Mr. Boyle found it true in Glasses sealed hermetically; and Glass is a Body as impervious as most are, to any Effluvia.

18. That the Power or Virtue of a Loadstone may be impaired by lying long in a wrong Posture, as also by Rust, Wet, &c. and may be quite destroyed by Fire.

The Orb of the Activity of Magnets is larger or less at different Times; which is confirmed by what is found in Fact to be true of our Noble Loadstone, which is kept in the Repository at the *Royal Society*; for that will keep a Key, or other Piece of Iron, suspended to another, sometimes at the Distance of eight or ten Foot from it; but at other Times, not beyond the Distance of four Foot.

MAGNETICAL AMPLITUDE, is an Arch of the Horizon, contained between the Sun at his Rising or Setting, and the East and West Point of the Compass; or it is the different Rising or Setting of the Sun from the East or West Points of the Compass; and is found by observing the Sun at his Rising or Setting, by an Amplitude Compass.

MAGNETISM, or MAGNETICAL ATTRACTION, is the Virtue or Power that the Loadstone has of drawing Iron to it.

MAGNETICAL AZIMUTH, is an Arch of the Horizon, contained between the Sun's Azimuth Circle, and the Magnetical Meridian; or it is the Apparent Distance of the Sun from the North or South Point of the Compass; and may be found by observing the Sun with an Azimuth Compass, when he is about

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ten or fifteen Degrees high, either in the Forenoon or Afternoon.

MAGNETICAL MERIDIAN. See *Meridian*.

MAGNETICAL NEEDLE, is the touched Needle of the Compass.

MAGNIFY, is a Word used chiefly with regard to Microscopes, being only the bringing the Object nearer to the Eyes, and letting some Parts of it be seen, which before were not discoverable by the bare Eye.

MAGNITUDE. The same as Bigness or Greatness.

MANTELETS, in Fortification, are a kind of moveable Pent-houses, and are made of Pieces of Timber sawed into Planks; which being about three Inches thick, are nailed one over another to the Height of almost six Foot. They are generally cased with Tin, and set upon little Wheels; so that in a Siege they may be driven before the Pioneers, and serve as Blinds to shelter them from the Enemy's Small-Shot. There are also other Sorts of Mantelets, covered on the Top, whereof the Miners make use to approach the Walls of a Town or Castle.

MAP, is a Description of the Earth, or some particular Part thereof, projected upon a plain Superficies; describing the Form of Countries, Rivers, Situation of Cities, Hills, Woods, and other Remarks.

MARINE BAROMETER. See *Barometer*.

MARS, the Name of one of the Planets which moves round the Sun in an Orbit between that of the Earth and *Jupiter*.

1. The mean Distance of

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Mars ♂ from the Sun is 1524, its Excentricity 141, the Inclination of its Orbit 1 Deg. 52 Min. Its Periodical Time 686 Days, 23 Hours. Its Revolution about its Axis is performed in 24 Hours, 40 Min.

2. This Planet (as well as the rest) borrows its Light from the Sun; and has its Increase and Decrease of Light like the Moon; and it may be seen almost bisected when in his Quadratures with the Sun, or in his Perigæon, but never corniculated or falcated, as the other Inferiors.

3. *March* 10. 1665. Dr. Hook observed this Planet, with a 36 Foot Tube, and saw its Body as large very near as the Moon at Full; and in it he observed several Spots, and particularly a triangular one; which having a Motion, he concluded the Planet to have a turbinated Motion round its Centre.

4. In the Year 1666, *February* the 6th in the Morning, Mr. *Cassini*, with a 16th Foot Telescope, observed two dark Spots in the first Face of *Mars*, moving from Eleven at Night until Break of Day.

5. *February* the 24th, in the Evening, he saw two other Spots in the other Face of this Planet, like those of the first, but much bigger; and continuing the Observations, he found the Spots of those two Faces to turn by a little and a little from East to West, and so return at the Space of 24 Hours, 40 Minutes to the same Situation, wherein they were seen at first.

6. Whence he concluded, that the Revolution of this Planet round its Axis, is performed in the

the Space of 24 Hours, 40 Minutes, or thereabouts.

7. The Magnitude of *Mars* to the Magnitude of the Earth, is as 216 to 343. and its Apparent Diameter, according to Mr. *Flamsteed* and *Cassini*, is 35".

8. That *Mars* hath an Atmosphere, like ours, is argued from the Phænomena of the fixed Stars appearing obscured, and, as it were, extinct, when they are seen just by the Body of *Mars*; and if so, a Spectator in *Mars* will hardly ever see *Mercury*, unless it may be seen in the Sun, when that Planet passes over his Disk like a Spot, as he doth sometimes to us.

MATHEMATICKS, originally signifies any Discipline or Learning, (*Matheſis*;) But now, 'tis properly that Science which teaches or contemplates whatever is capable of being numbered or measured, as it is computable or measurable.

And the Part of Mathematicks which relates to Number only, is called *Arithmetick*; that which relates to Measure in general, whether Length, Breadth, Motion, Force, &c. is called *Geometry*.

MATHEMATICAL HORIZON, is the same with true *Horizon*. See *Horizon*.

MATHEMATICKS may be reckoned either,

1. Pure, Simple, or Abstracted, which considers Abstracted Quantity, without any Relation to Matter, or sensible Objects. Or,

2. Mix'd Mathematicks, which is interwoven every where with Physical Considerations.

MATHEMATICKS also are divided into,

1. Speculative, which proposes only the simple Knowledge of the Thing proposed, and the bare Contemplation of Truth or Falshood. And

2. Practical, which teaches how to demonstrate something useful, or to perform something that shall be proposed for the Benefit and Advantage of Mankind.

MATTER, or BODY, is an impenetrable, divisible, and passive Substance, extending into Length, Breadth, and Thickness. This, when considered in general, remains the same in all the various Motions, Configurations, and Changes of Natural Bodies, being capable of putting on all Manner of Forms, and of moving according to all Manner of Directions and Degrees of Velocity; the Quantity of Matter in any Body, is its Measure arising from the Joint-Consideration of the Magnitude and Density of that Body; as if any Body be twice as dense as another, and take up twice the Space, 'twill be four times as great. This Quantity of Matter is best discoverable by Weight, to which 'tis always proportionable; as Sir *Isaac Newton*, by most accurate Observations on Pendulums, found true by Experience.

MAXIMIS and MINIMIS. The Mathematicians call that Method whereby a Problem is resolved, which requires the greatest or least Quantity attainable in that Case, *Methodus de Maximis & Minimis*.

1. If any flowing Quantity in a Equation proposed be required to be determined to any extreme Value.

2. Having

2. Having put the Equation into Fluxions, let the Fluxion of that Quantity (whose Extreme Value is sought) be supposed $=0$; by which Means all those Members of the Equation in which it is found, will vanish, and the remaining ones will give the Determination of the *Maximum* or *Minimum* desired.

MEAN ANOMALY. See *Anomaly*.

MEAN CONJUNCTION, is when the Mean Place of the Sun is the same with the Mean Place of the Moon in the Ecliptick. And a

MEAN OPPOSITION, is when the former is in Opposition to the latter.

MEAN MOTION, is that where-with a Planet, or any Point or Line is supposed to move equally in its Orbit, and is always proportional to the Time.

Sir Isaac Newton, in his *Theory of the Moon*, says, That the Sun and Moon's Mean Motions from the Vernal Equinox at the Meridian of *Greenwich*, are as follows, viz. the last Day of *December* 1680, *Old Style*, at Noon, the Sun's Mean Motion 9 fig. 20 deg. 34 min. 46 sec. That of the Sun's Apogæum 3 fig. 7 deg. 23 deg. 30 sec. The Moon's Mean Motion 6 fig. 1 deg. 45 min. 45 sec. That of the Moon's Apogæum 8 fig. 4 deg. 28 min. 5 sec. That of the ascending Node of the Moon's Orbit 5 fig. 24 deg. 14 min. 35 sec. And *December* the last Day, 1700, *Old Style*, at Noon, the Sun's Mean Motion was 9 fig. 20 deg. 43 min. 50 sec. That of the Sun's Apogæum 3 fig. 7 deg. 44 min. 30 sec. The Mean Motion of the Moon 10 fig. 15 deg.

19 min. 50 sec. Of the Moon's Apogæum 11 fig. 8 deg. 18 min. 20 sec. And of the Ascending Node 4 fig. 27 deg. 24 min. 20 sec. For in twenty *Julian* Years, or in 7305 Days, the Sun goes thro' 20 rev. 9 min. 4 sec. The Motion of the Sun's Apogæum 21 min. The Moon's Motion 267 rev. 4 fig. 13 deg. 34 min. 5 sec. The Motion of the Moon's Apogæum 2 rev. 3 fig. 3 deg. 50 min. 15 sec. Of the Node, 1 rev. 26 deg. 50 min. 15 sec. All the aforesaid Motions are from the Point of the Vernal Equinox. And if from them be substracted the Procession, or Retrograde Motion of the Equinoctial Point itself, which was moved in the mean Time in *Antecedentia*, viz. 16 min. 40 sec. The Motions will remain in respect of the fixed Stars in twenty *Julian* Years; the Motion of the Sun, 19 rev. 11 fig. 29 deg. 52 min. 24 sec. That of the Sun's Apogæum 4 min. 20 sec. of the Moon, 247 rev. 4 fig. 13 deg. 17 min. 25 sec. Of the Moon's Apogæum, 2 rev. 3 fig. 3 deg. 33 min. 35 sec. Of the Moon's Node, 1 rev. 27 deg. 6 min. 55 sec.

MEAN DISTANCE of a Planet from the Sun, is the Right Line



SP, drawn from the Sun *S* to *P*, the Extremity of the Conjugate Axis

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Axis of the Ellipsis the Planet moves in, and this is equal to the Semi-Transverse Axis DC, and is so call'd, because it is an Arithmetical Mean between the Planet's greatest and least Distance from the Sun.

MEAN DIAMETER in Gauging, is a Geometrical Mean between the Diameters at Head and Bung in any close Cask.

MEAN and EXTREAM PROPORTION. See *Extream and Mean Proportion*.

MEAN or MIDDLE PROPORTION between any two Lines or Numbers, is that which hath the same Proportion to a third Term that the first bears to it.

1. Thus 6 is a Mean Proportional between 4 and 9, because $4:6::6:9$.

2. The Square of a Mean Proportional is equal to the Rectangle under the Extremes.

3. Two Mean Proportionals between two Extreams cannot be found by a Straight Line and a Circle; but it may be done by the Conick Sections very easy, or by the Conchoid, or Cissoid.

MEASURE, in Musick, is a

ME

Quantity of the Length and Shortness of Time, either with respect to natural Sounds pronounced by the Voice, or artificial, drawn out of Musical Instruments; which Measure is adjusted in Variety of Notes, by a constant Motion of the Hand or Foot, down or up, successively and equally divided; so that every Down or Up is called a *Time* or *Measure*, whereby the Length of a Semi-Breve is measured, which is therefore termed the *Measure-Note*, or *Time-Note*.

MEASURE of an Angle, is an Arch of a Circle described about the Angular Point.

MEASURE of a Number, is the Number that measures it; as 2 is the Measure of 4.

MEASURE of a Ratio, is a Logarithm.

MEASURE of a Solid, is a Circle, whose Side is one Inch, Foot, Yard, or other determinate Length.

MEASURE of a Superficies, or plain Figure, is a Square, whose Side is one Inch, Foot, Yard, &c.

Here

Here follows several very useful TABLES of different Measures.

A TABLE of the Foreign Measures, carefully compared with the English.

| | | Suppose an English Foot divided into 1000 equal Parts, those here mentioned are in Proportion to it, as follows, | The English Foot divided into Inches, and Decimal Parts of an Inch. | | |
|---|---------------------------------|--|---|----|---|
| London | Foot | 1.000 | 0 | 12 | 0 |
| Paris | <i>the Royal</i> Foot | 1.068 | 1 | 00 | 8 |
| Amsterdam | Foot | .942 | 0 | 11 | 3 |
| Brill | Foot | 1.103 | 1 | 01 | 2 |
| Antwerp | Foot | .946 | 0 | 11 | 3 |
| Dort | Foot | 1.184 | 0 | 02 | 2 |
| Rynland or Leyden | Foot | 1.033 | 1 | 00 | 4 |
| Lorrain | Foot | .958 | 0 | 11 | 4 |
| Mechlin | Foot | .919 | 0 | 11 | 0 |
| Middleburgh | Foot | .991 | 0 | 11 | 9 |
| Strasburgh | Foot | .920 | 0 | 11 | 0 |
| Bremen | Foot | .964 | 0 | 11 | 6 |
| Cologn | Foot | .954 | 0 | 11 | 4 |
| Frankford ad Manam | Foot | .948 | 0 | 11 | 4 |
| Spanish | Foot | 1.001 | 1 | 00 | 0 |
| Toledo | Foot | .899 | 0 | 10 | 7 |
| Roman | Foot | .967 | 0 | 11 | 6 |
| On the Monu-
ment of | { Cestucius }
{ Statilius. } | .972 | 0 | 11 | 7 |
| Bononia | Foot | 1.204 | 1 | 02 | 4 |
| Mantua | Foot | 1.569 | 1 | 06 | 8 |
| Venice | Foot | 1.162 | 1 | 01 | 9 |
| Dantzick | Foot | .944 | 0 | 11 | 3 |
| Copenhagen | Foot | .965 | 0 | 11 | 6 |
| Prague | Foot | 1.026 | 1 | 00 | 3 |
| Riga | Foot | 1.831 | 1 | 09 | 9 |
| Turin | Foot | 1.062 | 1 | 00 | 7 |
| The Greek | Foot | 1.007 | 1 | 00 | 1 |
| Paris Foot, according to
Dr. Bernard | { | 1.066 | | | |
| Universal | Foot | 1.089 | | | |
| Old Roman | Foot | .970 | | | |

M E

M E

Bononian Foot of M. Auzout

| | | | | | |
|---|--------------|-------|---|----|--------------------|
| Lyons | Ele | 3.976 | 3 | 11 | 7 |
| Bologn | Ell | 2.056 | 2 | 00 | 8 |
| Amsterdam | Ell | 2.269 | 2 | 03 | 2 |
| Antwerp | Ell | 2.273 | 2 | 00 | 2 |
| Rynland or Leyden | Ell | 2.260 | 2 | 03 | 1 |
| Frankford | Ell | 1.826 | 1 | 09 | 9 |
| Hamburgh | Ell | 1.905 | 1 | 10 | 8 |
| Leipsick | Ell | 2.260 | 2 | 03 | 1 |
| Lubeck | Ell | 1.908 | 1 | 09 | 8 |
| Noremburgh | Ell | 2.227 | 2 | 03 | 3 |
| Bavaria | Ell | .954 | 0 | 11 | 4 |
| Vienna | Ell | 1.053 | 1 | 00 | 6 |
| Bononia | Ell | 2.147 | 2 | 01 | 7 |
| Dantzick | Ell | 1.903 | 1 | 10 | 8 |
| Florence | Brace or Ell | 1.913 | 1 | 11 | 0 |
| Spanish or Castile | Palm | .751 | 0 | 09 | 0 |
| Spanish Vane or Rod, which
is four Palms | | 3.001 | 1 | 00 | 0 |
| Lisbon | Vare | 2.750 | 2 | 09 | 0 |
| Gibraltar | Vare | 2.760 | 2 | 09 | 1 |
| Toledo | Vare | 2.685 | 2 | 08 | 2 |
| Naples | Palm | .861 | 0 | 09 | 6 |
| | Brace | 2.100 | 2 | 01 | 2 |
| | Canna | 6.880 | 6 | 10 | 5 |
| Genoa | Palm | .830 | 0 | 09 | 6 |
| Milan | Calamus | 6.544 | 6 | 06 | 5 |
| Parma | Cubit | 1.866 | 1 | 10 | 4 |
| China | Cubit | 1.016 | 1 | 00 | 2 |
| Cairo | Cubit | 1.824 | 1 | 09 | 9 |
| Old | Babylonian | Cubit | 1 | 06 | $\frac{24}{100}$ |
| | Greek | | 1 | 06 | $\frac{13}{100}$ |
| | Roman | | 1 | 05 | $\frac{496}{1000}$ |
| Turkish | Pike | 2.200 | 2 | 02 | 4 |
| Persian | Arash | 3.197 | 3 | 02 | 3 |

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A TABLE of English Long Measure.

| Inches. | | | | | | | | | |
|---------|-------|-----------------|------------------|-----------------|-----------------|-----------------|------------------|-----------------|----------|
| 3 | Palm. | | | | | | | | |
| 9 | 3 | Span. | | | | | | | |
| 12 | 4 | 1 $\frac{1}{3}$ | Foot. | | | | | | |
| 18 | 6 | 2 | 1 $\frac{1}{2}$ | Cubit. | | | | | |
| 36 | 12 | 4 | 3 | 2 | Yard. | | | | |
| 45 | 15 | 5 | 3 $\frac{3}{4}$ | 2 $\frac{1}{2}$ | 1 $\frac{1}{4}$ | Ell. | | | |
| 60 | 20 | 6 $\frac{2}{3}$ | 5 | 3 $\frac{1}{2}$ | 1 $\frac{2}{3}$ | 1 $\frac{1}{4}$ | Pace. | | |
| 72 | 24 | 8 | 6 | 4 | 2 | 1 $\frac{1}{2}$ | 1 $\frac{1}{4}$ | Fath. | |
| 198 | 66 | 22 | 16 $\frac{2}{3}$ | 11 | 5 $\frac{1}{2}$ | 1 $\frac{3}{4}$ | 4 $\frac{1}{10}$ | 2 $\frac{3}{4}$ | Pole. |
| 7920 | 2640 | 880 | 660 | 440 | 220 | 176 | 132 | 10 | 40 Furl. |
| 63360 | 21120 | 7040 | 5280 | 3520 | 1760 | 1408 | 1056 | 880 | 320 8 M. |

A TABLE of Square Measure.

| Inches square. | | | | | |
|----------------|----------|-----------|-----------|-----------|---------------|
| 144 | Feet sq. | | | | |
| 1296 | 9 | Yards sq. | | | |
| 3600 | 25 | 2.77 | Paces sq. | | |
| 39204 | 272.25 | 30.25 | 10.89 | Poles sq. | |
| 1568160 | 10890 | 1210 | 435.6 | 40 | Rood sq. |
| | 43560 | 4840 | 1742.4 | 160 | 4 Acres sq. |
| | | 3097600 | 1115136 | 10240 | 256640 Miles. |

A TABLE of Dry Measure.

| Pints. | | | | | | | | | |
|--------|----------|--------|----------|----------|-------------------|-------------------|-------|-------|-------|
| 8 | Gallons. | | | | | | | | |
| 16 | 2 | Pecks. | | | | | | | |
| 64 | 8 | 4 | Bushels. | | | | | | |
| 128 | 16 | 8 | 2 | Strikes. | | | | | |
| 256 | 32 | 16 | 4 | 2 | Carnock, or Coom. | | | | |
| 512 | 64 | 32 | 8 | 4 | 2 | Seem, or Quarter. | | | |
| 3072 | 384 | 102 | 48 | 24 | 12 | 6 | Way. | | |
| 5120 | 640 | 320 | 80 | 40 | 20 | 10 | 12 | Last. | |
| 1 lb. | 8 lb. | 16 | 64 | 128 | 256 | 512 | 3072 | 5120 | Troy. |
| 14 oz. | 7 lb. | 14 | 56 | 1 C. | 2 C. | 4 C. | 24 C. | 40 C. | Aver. |

A TABLE of Wine Measure, Honey, Oil, &c.

| | Gall. | | Pints. | |
|---------------|-------|--------|--------|-------|
| | 18 | | 8 | |
| Rundl. | 18 | 144 | | |
| Barrels. | 1 1/2 | 31 1/2 | 252 | |
| Terces. | 1 1/2 | 3 1/2 | 42 | 336 |
| Hogshead. | 1 1/2 | 2 | 3 1/2 | 63 |
| Punch. | 1 1/2 | 2 | 2 2/3 | 4 2/3 |
| But, or Pipe. | 1 1/2 | 2 | 3 | 4 |
| Tun. | 2 | 3 | 4 | 6 |
| | 8 | 14 | 1452 | 2016 |

A TABLE for Beer Measure.

| | Gall. | | Pints. | |
|-----------|-------|----|--------|-----|
| | 8 | | | |
| Firk. | 9 | 72 | | |
| Kilderk. | 2 | 18 | 144 | |
| Barrels. | 2 | 4 | 36 | 288 |
| Hogshead. | 2 | 4 | 8 | 72 |
| | | | | 576 |

A TABLE for Ale Measure.

| | Gall. | | Pints. | |
|-----------|-------|----|--------|-----|
| | 8 | | | |
| Firk. | 9 | 64 | | |
| Kilderk. | 2 | 18 | 128 | |
| Barrels. | 2 | 4 | 36 | 256 |
| Hogshead. | 2 | 4 | 8 | 72 |
| | | | | 512 |

MECHANICKS, is the Geometry of Motion, being that Science which shews the Effect of Powers or moving Forces, so far as they are applied to Engines, and demonstrates the Laws of Motion.

MECHANICK POWERS (as they are called) are six, viz. the *Balance*, the *Leaver*, the *Wheel*, the *Pulley*, the *Wedge*, and the *Screw*; to some or other of which, the Force of all Mechanical Inventions must necessarily be reduced. See those Words.

MECHANICAL PHILOSOPHY, is the same with the Corpuscular, which endeavours to explicate the Phænomena of Nature from Mechanical Principles, i. e. from the Motion, Rest, Figure, Position, Magnitude, &c. of the Minute Particles of Matter. And these Principles are frequently called

MECHANICAL CAUSES: And also the

MECHANICAL AFFECTIONS of Matter.

MECHANICAL CURVE, is one whose Nature cannot be express'd by an *Algebraick Equation*.

MECHANICAL SOLUTION of a Problem, in Mathematicks, is either when the Thing is done by repeated Tryals, or when the Lines made use of to solve it, are not truly Geometrical. Thus the Method of *Nicomedes*, *Eratosthenes*, *Pappus*, and *Vieta*, for finding two Mean Proportionals; and that of *Nicodemus* and *Dionysistratus*, for dividing an Angle into any Parts assigned, by Means of the *Quadratrix*, is Mechanical; because the former is done by repeated Tryals, and the latter by Means of a Curve that is not truly Geometrical.

MEDIUM, in Natural Philoso-

phy, signifies that peculiar Constitution of any Space or Region through which Bodies move. Thus the *Æther* is supposed by some to be the Medium in which the Planets and Heavenly Bodies move: The Air is the Medium in which all Meteors are generated and move; and by the Means of which it is, that all Animals, as Insects, Birds, Beasts, and Men, can breath and live: But Water is the Medium in which Fishes live and move. Glass is also called a *Medium*.

MEMBRETTA, in Architecture, is the *Italian Term* for a Pilaster, that bears up an Arch. These are often fluted, but not with above seven or nine Channels. They are frequently used to adorn Door-Cases, Gallery-Fronts, and Chimney-Pieces, and to bear up the Cornishes and Freezes in Wainscot.

MENISCUS GLASSES, are those which are Convex on one Side, and Concave on the other.

As the Difference of the Semi-Diameters of the Convexity and Concavity, to the Semi-Diameter of the Concavity, so is the Diameter of the Convexity to the Focal Length.

MENSURABILITY, is an Aptitude in a Body, whereby it may be applied or conformed to a certain Measure.

MENSURATION, or **MEASURING**, is to find the Superficial Area, or Solid Content of Surfaces and Bodies.

MERCATOR'S CHART, or **PROJECTION**, is a Projection of the Face of the Earth in *Plano*, wherein the Meridians, Parallels, and Rhumb-Lines, are all Straight Lines, and the Degrees of Longitude are all equally distant from

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from one another; but the Degrees of Latitude increase towards the Poles in the same Proportion, that the Parallel-Circles on the Globe decrease; viz. in the Ratio of the Radius to the Sine-Complement of the Latitude.

1. Though the plain Chart be very easy and useful in short Voyages, and will serve in the longer Voyages, if you sail Home in or near the opposite Rhumb you went by, as the Antients, who being Coasters, did before the Use of the Compass; yet forasmuch as few Places, or indeed none, but such as lie under the Equinoctial, can therein be expressed according to their true Situation and Distance one from another; but if they be laid down true by the Course and Distance, the Difference of Longitude will be false; if they be laid down by the Course and Difference of Longitude, then will the Distance and Difference of Latitude be more than it should be; and if they be laid down by the Distance and Difference of Longitude, (which in many Cases is impossible,) then the Difference of Latitude will always be too little, and the Rhumb too wide from the Meridian; and if they be laid down by their Latitudes and Departure, then the Course will be wide, and the Distance too much, &c.

2. It was the great Study of our Predecessors to contrive such a Chart in *Plano*, with Straight Lines, on which all or any Parts of the World might be truly set down, according to their Longitudes, Latitudes, Bearings, or Distances.

3. A Way was hinted for this

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near two thousand Years since by *Ptolemy*, and a General Map according thereto, made in the preceding Age by one *Mercator*, but the Thing demonstrated, and a Ready Way shewed of describing it, was not till Mr. *Wright* taught to enlarge the Meridian-Line by the continual Addition of Secants; so that all Degrees of Longitude might be proportional to those of Latitude, as on the Globe: Which he has done after such an excellent Manner, that in many Respects it is far more convenient for the Navigator's Use, than the Globe itself, and will truly shew the Course and Distance from Place to Place, which Way soever a Ship sails forth, or returns.

4. The *Meridian Line*, in *Mercator's* Chart, is a Scale of Logarithmick Tangents of the Half-Complements of the Latitude.

The Differences of Longitude on any Rhumb, are the Logarithms of the same Tangents, but of a different Species; being proportioned to one another, as are the Tangents of the Angles made with the Meridian.

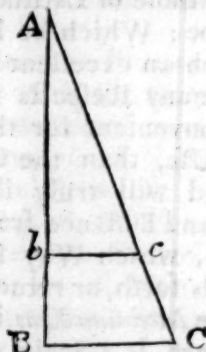
Hence any Scale of Logarithmick Tangents is a Table of the Differences of Longitude, to several Latitudes, upon some Determinate Rhumb or other; and therefore, as the Tangent of the Angle of such a Rhumb, to the Tangent of any other Rhumb; so is the Differences of the Logarithms of any two Tangents, to the Difference of Longitude on the proposed Rhumb, intercepted between the two Latitudes, of whose Half-Complements you took the Logarithmick Tangents.

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Here follow the several Cases, and their Proportions, in Mercator's Sailing.

1. One Latitude, Course, and Distance given: to find the other Latitude, Departure, and Difference of Longitude.

In the Right-angled Triangle ABC , the Line Ac represents the Distance: Ab the Difference of Latitude: bc the Departure;



as in plain Sailing; AB the Meridional Difference of Longitude, according to the true Chart, commonly called *Mercator's Chart*.

For the Departure, as the Radius to the Distance Ac , so is the Sine of the Course bAc , to bc the Departure.

For the Difference of Latitude: As the Radius to the Distance Ac , so is the Sine of $Ac b$ the Complement of the Course to the Difference of Latitude Ab .

For the Difference of Longitude: As the Radius to AB the Meridional Difference of Latitude, so is the Tangent of the Course BAC , to BC the Difference of Longitude.

2. Both Latitudes and Course given to find the Distance, Departure, and Difference of Longitude.

For the Distance: As the Radius, to Ab the Difference of Latitude; so is the Secant of bAc

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to the Course Ac the Distance.

For the Departure: As the Radius is to the Distance Ac ; so is the Sine of bAc the Course to bc the Departure.

For the Difference of Longitude: As the Radius is to AB , the Meridional Difference of Latitude; so is the Tangent of BAC the Course to BC the Difference of Longitude.

3. Both Latitudes and Distance given: to find the Course, Departure, and Difference of Longitude.

For the Course: As the Distance Ac is to the Radius, so is Ab the Difference of Latitude, to the Sine of $Ac b$ the Complement of the Course.

For the Departure: As the Radius is to the Distance Ac , so is the Sine bAc , the Course to bc the Departure.

For the Longitude: As the Radius is to the Meridional Difference of Latitude AB , so is the Tangent of BAC the Course to BC , the Difference of Longitude.

4. Both Latitudes and Difference of Longitude given: to find the Course, Distance, and Departure.

For the Course: As AB the Meridional Difference of Latitude, is to the Radius; so is BC the Difference of Longitude; to the Tangent BAC , of the Course.

For the Distance: As the Radius is to AB the Difference of Latitude, so is the Secant of BAC the Course, to Ac the Distance.

For the Departure: As the Radius is to Ac the Distance; so is the Sine of bAc the Course, to bc the Departure. Or, as the Radius is to Ab the Difference of Latitude; so is the Tangent of

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of bAc the Course, to bc the Departure.

5. One Latitude, Course, and Difference of Longitude given, to find the other Latitude, Distance, and Departure.

For the Latitude : As the Tangent of BAC the Course, is to BC the Difference of Longitude ; so is the Radius to the Meridional Difference of Latitude AB .

For the Distance : As the Radius is to Ab , the Difference of Latitude ; so is the Secant of bAc the Course, to Ac of the Distance.

For the Departure : As the Radius is to Ab the Distance, so is the Sine of bAc the Course, to the Departure bc .

6. Both Latitudes and Departure given : to find the Course, Distance, and Difference of Longitude.

For the Course : As the Difference of Latitude Ab is to the Radius, so is the Departure bc , to the Tangent of bAc the Course.

For the Distance : As the Sine Ac the Complement of the Course to the Difference of Latitude Ab ; so is the Radius to the Distance Ac .

For the Longitude : As the Radius is to the Meridional Difference of Latitude AB ; so is the Tangent of BAC the Course, to the Difference of Longitude BC .

MERCATOR'S SAILING, is the Art of finding on a Plane the Motion of a Ship upon any assigned Course, true in Longitude, Latitude, and Distance ; the Meridians being all parallel, and the Parallels of Latitude Straight Lines.

MERCURY, is the Name of one of the Planets, revolving about the Sun.

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MERCURY, is the least distant from the Sun of any of the Planets ; its mean Distance from the Sun is 387, its Excentricity 80, the Inclination of its Orbit is 6 deg. 52 min. It performs its Revolution round the Sun in 87 Days, 23 Hours. Its greatest Elongation is about 18 Degrees. There has not yet been observ'd any Spots in it ; neither do we know whether it revolves about its Axis ; but it is probable it does. Its Magnitude to that of the Earth is as 216 to 343.

In the Years 1736, 1743, 1756, 1769, 1776, 1782, 1789, in October, this Planet will be seen in the Sun near the ascending Node ; and in the Years 1753, 1786, 1799, it will appear in the Sun, in the Month of April, near the other Node.

MERIDIAN, is a great Circle passing through the Poles of the World, and both *Zenith* and *Nadir*, crossing the Equinoctial at Right Angles, and divideth the Sphere into two equal Parts, one East, the other West, and hath its Poles in the East and West Points of the Horizon. 'Tis called *Meridian*, because when the Sun cometh to the South Part of this Circle, 'tis then *Meridies*, *Mid-Day*, or *High-Noon* ; and then the Sun hath his greatest Altitude for that Day, which therefore is called the *Meridian Altitude*.

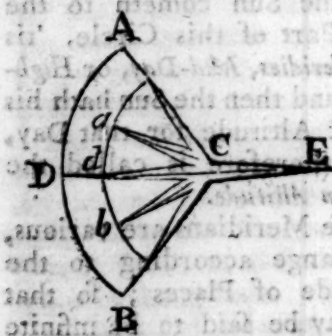
These Meridians are various, and change according to the Longitude of Places ; so that they may be said to be infinite in Number ; for that all Places from East to West have their several Meridians ; but there is (or should be) one fixed, which is called the *First Meridian*.

MERIDIAN on the *Globe or Sphere*, is represented by the Brazen Circle, in which the Globe hangs and turns. 'Tis divided into four 90's, or 360 Degrees, beginning at the Equinoctial on it. Each Way from the Equinoctial, on the Celestial Globes, is counted the South and North Declination of the Sun or Stars; and on the Terrestrial Globe, the Latitude of Places, North or South.

Upon the Terrestrial Globes there are usually drawn 36 Meridians, thro' every 10th Degree of Longitude.

MERIDIAN LINE, is the common Section of the Meridians, and the Plane of the Horizon, and so runs on North and South.

1. To draw a Meridian Line, there are several Ways, and many Instruments have been contriv'd for that Purpose; but the following Method is a very easy and good one. In an Horizontal Plane, which is easy to determine, describe several Concentrick Circles *BA, ba, &c.* And in the Centre *C* erect a Pin



of about a Foot long, perpendicular to the Plane. About the Time of the Tropicks before Noon, from Nine to Eleven,

and in the Afternoon, from about One to Three, mark the Points *B, b, &c. A, a, &c.* where in the Shadow of the Pin terminates, and bise& the Arches *AB, ab, &c.* in *Dd, &c.* Then if the same Straight Line *DE* does bise& all the Arches *AB, ab, &c.* that will be the Meridian Line sought.

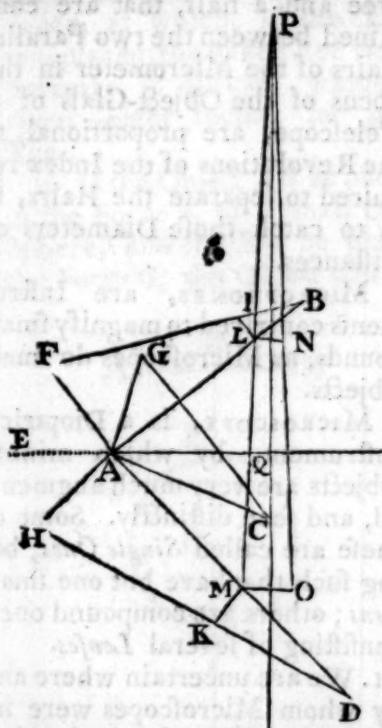
This Method would be very exact, if the Sun moved as the fixed Stars do; but because the Sun hath a proper Motion, as a Planet, there will be some inconsiderable Error, which yet may be corrected; for seeing the Sun in one Minute of an Hour moveth as much by his daily Motion, as he loseth in six Hours by his proper Motion, you shall add as much in the Way which the Shadow goes in the last Marks, as that Shadow moveth in one Minute, which you may measure by your Pulse or Pendulum; so the last Points will not be taken just in the Circles, but a little without it.

If *AB, AC*, and *AD*, be three Shadows, made in one Day, upon an Horizontal Plane, by the Pin *AE*, perpendicular to that Plane, the Meridian Line may be drawn thus:

If two of these Shadows are equal, then the Line drawn from the Point *A*, perpendicular to a Line joining their Extremes, will be the Meridian; but if not, let *AC* be the least. In the Point *A* you must raise the Lines *AF, AG*, and *AH*, perpendicular to *AB, AC*, and *AD*, and equal to *AE*, and join *FB, GC, HD*. Now from *FB, HD*, take *FI, HK*, equal to *GC*; and from the Points *I* and *K* draw

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the Right Lines IL , KM , perpendicular to AB , AD , and from the Points L , M , you must



let fall two more Perpendiculars LN , MO , to the Line joining L and M , which let be equal to LI and MK . Now, let P be the Intersection of the Lines joining the Points M , L , and O , N . Then, if a Right Line be drawn thro' P and C , a perpendicular from A to the Line CP , will be the Meridian.

MERIDIAN LINE, or **GUNTER'S SCALE**, is divided unequally towards 37 Degrees, (whereof 30 Degrees are about one Half) in such Manner as the Meridian in *Mercator's Chart* is divided and number'd.

Its Uses are many. For, 1. It serves to graduate a Sea-Chart according to the true Projection. 2. Being joined with a Line of Chords, it serves for the Protraction and Resolution of such

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Right-Lined Triangles as are concerned in Latitude, Longitude, Rhumb, and Distance, in the Practice of Sailing; as also in Pricking the Chart truly at Sea.

MERIDIAN (MAGNETICAL), is a great Circle passing through or by the Magnetical Poles; to which Meridians, the Compass (if not otherwise hinder'd) hath respect.

MERIDIONAL DISTANCE, in Navigation, is the same with the *Departure*, Easting or Westing, or under which the Ship now is, and any other Meridian she was before under.

MERIDIONAL PARTS, MILES, or MINUTES, in Navigation, are the Parts by which the Meridians in *Mercator's Chart*, do increase as the Parallels of Latitude decrease.

And the Co-Sine of the Latitude of any Place being equal to the Radius or Semi-Diameter of that Parallel, therefore in *Mercator's Chart*, this Radius being the Radius of the Equinoctial, or whole Sine of 90° , the Meridional Parts at each of the Arches contained between that Latitude and the Equinoctial do decrease.

The Tables therefore of Meridional Parts, which you have in Books of Navigation, are made by the continual Addition of Secants, and calculated in some Books (as in Sir *Jonas Moore's Tables*) for every Degree and Minute of Latitude, and these will serve either to make or graduate a *Mercator's Chart*, or to work *Mercator's Sailing*.

MERLON, in Fortification, is that Part of the Parapet which lies betwixt two Embrasures, being from eight to nine Foot long

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long on the Side of the Cannon, and six on the Side of the Field ; as also six Foot high, and eighteen thick.

MESOLABIUM, is the Name of an Instrument for finding mean Proportionals.

METAL. The Outside or Surface of a Piece of Ordnance, is called the *Superficies of her Metal* : When the Mouth of a great Gun lies lower than her Breech, they say, She lies under Metal ; but if she lies truly level, point-blank, or right with the Mark, they say, She lies right with her Metal.

METOPS, is the square Space between the Triglyphs of the Doric Freeze, which among the Antients used to be adorned with the Heads of Beasts, Basons, Vases, and other Instruments used in sacrificing. A Demi-Metops is a Space somewhat less than half a Metops, at the Corner of the Doric Freeze.

MICROCOUSTICKS, the same with *Microphones*.

MICROMETER, is an Instrument fitted to a large Telescope in the Focus of the Object-Glass, for measuring the Apparent Diameters of the Celestial Bodies, and small Distances that do not exceed a Degree, or a Degree and an half.

There are several Sorts of these Instruments, whereof some are Movements consisting of a Plate or Face divided like a Clock or Watch, with an Index or Hand, which being turn'd, moves two sliding Plates of Brass that carry two Parallel Hairs, and counts on the Plate the Revolutions of the Screws that move the Plates, whose Threads are extremely fine.

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The Apparent Diameters for the Distances of any Objects that are less than a Degree, or a Degree and a half, that are contained between the two Parallel Hairs of the Micrometer in the Focus of the Object-Glass of a Telescope, are proportional to the Revolutions of the Index required to separate the Hairs, so as to catch those Diameters or Distances.

MICROPHONES, are Instruments contrived to magnify small Sounds, as Microscopes do small Objects.

MICROSCOPE, is a Dioptrick Instrument, by which minute Objects are very much augmented, and seen distinctly. Some of these are called *Single Ones*, being such that have but one small Lens ; others are compound ones, consisting of several Lenses.

1. We are uncertain where and by whom Microscopes were invented ; but this we know, that they were unknown till the Year 1618, because Hieronymus Surturus, who writ a Book that Year of the Invention and Fabrick of the Telescope, makes no Mention of them.

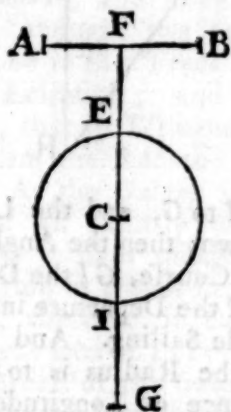
2. Mr. Huygens, in his *Dioptricks*, will have one Drebbel, a Dutchman, to be the Inventer of the Double or Compound Microscope in the Year 1621 ; and Francis Fontana, a Neapolitan, in a Book of *Observations*, published by him in the Year 1646, says, that he himself happen'd upon the Invention of the Compound Microscope in the Year 1621.

3. If an Object be placed in the Focus of the Convex-Lens of a single Microscope, and the Eye be very near on the other Side, the Object will appear distinct in

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an erect Situation, and augmented in the Ratio of the Focal Distance of the *Lens*, to such a Distance, at which, if the Object was placed, the naked Eye would perceive it distinct, which is about eight Inches for good Eyes.

4. If the Object *AB* be placed in the Focus *F*, of a small Glass Sphere, and the Eye be put in the Focus *G*, the Object will ap-



pear Distinct, and in an erect Posture augmented; as to Diameter in the Ratio of $\frac{1}{2}$ of the Diameter *EI* to the Distance of about eight Inches. If the Diameter of the small Sphere be $\frac{1}{10}$ of an Inch; then $CE = \frac{1}{20}$, and $FE = \frac{1}{40}$, and so $FC = \frac{1}{40}$. Whence the true Diameter of the Object to the Apparent, is as 1 to 103 nearly.

5. Microscopes made of small Glass Spheres will magnify Objects more than those made of Lenses; because small Glass Spheres may be made far more little than Lenses. If the Diameter of a Sphere be $\frac{1}{16}$ of an Inch; it will magnify the Diameter of an Object in the Ratio of 1 to 170 nearly; the Superficies in the Ratio of 1 to 28900, and the

Solidity in the Ratio of 1 to 4913000.

6. The more an Object is amplified by a Microscope, the less Part thereof is comprehended at one View.

7. The Appearance of any given Object, formed by any given Glass or Combination of Glasses, becomes obscure in such Proportion as its Magnitude increases.

8. Equal Appearance of the same Object, formed by different Combinations, become obscure in such Proportion, as the Number of Rays constituting each Pencil decreases, that is, in Proportion to the Smallness of the Object-Glass.

9. Wherefore, if the Diameter of the Object-Glass exceeds the Diameter of the Pupil, as many Times as the Diameter of the Appearance exceeds the Diameter of the Object; the Appearance shall appear as clear and bright as the Object itself.

10. The Diameter of the Object-Glass cannot be so much increased, without increasing at the same Time the Focal Distances of all the Glasses, and consequently the Length of the Instrument: Otherwise the Rays would fall too obliquely upon the Eye-Glass, and the Appearance become confused and irregular.

11. Sir Isaac Newton, in his *Opticks*, Book II. Part III. says, That if Microscopes, are or can be so far improved as with sufficient Distinctness to represent Objects five or six hundred Times bigger than at a Foot distance they appear to the naked Eye; he hoped that we might be able to discover some of the greatest of the

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the Corpuscles of Bodies; and by one which would magnify three or four thousand Times, perhaps, all those that produce Blackness might be discovered. And if this could be attained to, (*viz.* by Glasses to discover the Constituent Particles of Bodies) he fears it would be the utmost Improvement of this Sense of Seeing; for it seems impossible to see the most secret and noble Works of Nature within the Corpuscles, because of the Transparency of the Corpuscles.

12. The same Gentleman in *Philos. Transf.* N^o 88. from the Difference he had found between compound and simple Colours, takes Occasion to communicate a Way for the Improvement of Microscopes by Refraction, *viz.* by illuminating the Object in a darken'd Room with Light of any convenient Colour not too much compounded; by which Means the Microscopes will with Distinctness bear a deeper Charge, and a larger Aperture.

13. And in N^o 80. he saith, That he hath sometimes thought of making a Microscope, which should have, instead of an Object-Glass, a Reflecting Piece of Metal.

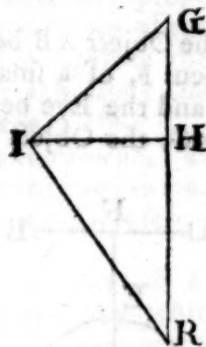
MIDDLE LATITUDE, in Navigation, is half the Sum of two Latitudes. And

MIDDLE LATITUDE SAILING, is the Manner of solving the several Cases of *Mercator's* Sailing, without the Meridional Parts, by taking the Middle Latitude; and this nearly agrees with *Mercator's* Sailing.

If the Line GR be drawn, and the Angle GRI be made at

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R , equal to the Complement of the Middle Latitude: And the Difference of Longitude be set from R to I , and the Perpendicular IH be let fall, and the Difference of Latitude be set off



from H to G , and the Line IG be drawn; then the Angle IGH is the Course, GI the Distance, and IH the Departure in Middle Latitude Sailing. And

As the Radius is to RI the Difference of Longitude, so is the Sine of HRI the Complement of the Middle Latitude, to HI the Departure; and as GH the Difference of Latitude to the Radius, so is HI the Departure to the Tangent of HGI the Course.

And as the Sine of HGI the Course, to IH the Departure, so is the Radius to IG the Distance.

MILKY-WAY, VIA LACTEA, or GALAXY, is a broad white Path or Track, encompassing the whole Heavens, and extending itself in some Places with a double Path; but for the most part with a single one. Some of the Antients, as *Aristotle*, &c. imagined that this Path consisted only of a certain Exhalation hanging in the Air; but by the Telescopical Observations it hath been discovered to consist of an innume-

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innumerable Quantity of fixed Stars, different in Situation and Magnitude, from the confused Mixture of whose Light, its white Colour is supposed to be occasioned. It passes through the Constellations of *Cassiopeia*, *Cygnus*, *Aquila*, *Perseus*, *Andromeda*, Part of *Ophiucus* and *Gemini*, in the Northern Hemispheres; and in the Southern, it takes in Part of *Scorpio*, *Sagittarius*, *Centaurus*, the *Argonavis*, and the *Ara*.

Metrodorus, and some *Pythagoreans*, thought the Sun had once gone in this Track instead of the *Ecliptick*; and consequently, that its Whiteness proceeds from the Remains of his Light. As the *Galaxy* is composed of an Infinity of small Stars, so it hath usually been the Region in which new Stars appears, the Star in *Cassiopeia*, which was seen A.D. 1572. that in the Breast of the Swan, and another in the Knee of *Serpentarius*, and several others, which have appeared for a while, and then become invisible again.

MILITARY ARCHITECTURE, the same with *Fortification*.

MINE, in Fortification, is a Hole dug or made by a Pioneer under the Rampart, or under the Face of the Bastion, whereto there are several oblique and winding Passages: When it is finished, divers Barrels of Powder are placed therein, together with a Train or Saucidge; and the Quantity of Powder is proportioned to the Height and Weight of the Body which is to be blown up.

There are also Mines sprung in the Field, which are called *Fougades*. The Alley or Passage of a Mine is usually about four

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Foot square; at the End of which is the *Chamber of the Mine*, as they call it. The farther it is carry'd on, the more it is subject to be discovered by the Enemy. Therefore, 'tis best not to aim at mining too far, and to make a new one where the former takes no Effect.

MINE-DIAL, is a Box and Needle, with a brass Ring divided into 360 Degrees, with several Dials graduated thereon, generally made for the Use of Miners.

MINIM, a Term in Musick; being the fourth Note of Time, and is mark'd thus q.

MINION, a sort of a Cannon, is either large or ordinary. The large Minion is one of the longest Size, and has its Bore three Inches and a quarter Diameter, and is a thousand Pound Weight. Its Load is three Quarters of a Pound of Powder: Its Shot three Inches Diameter, and three Pound three Quarters Weight: Its Length eight Foot, and its Level-Range a hundred and twenty five Paces.

The ordinary Minion: Its Bore is three Inches in Diameter, and weighs about eight hundred or seven hundred and fifty Pounds Weight: It is seven Foot long: Its Load two Pounds and a half of Powder: Its Shot near three Inches Diameter, and weighs three Pounds and four Ounces; and it shoots point-blank a hundred and twenty Paces.

MINUTE, is the 60th Part of a Degree or Hour.

MINUTE, in Architecture, is sometimes taken for a Part of a Module

MITRE,

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MITRE, in Architecture, is the Workmens Term for an Angle, that is, just forty five Degrees, or half a Right one; and if it be a Quarter of a Right Angle, they call it a *Half Mitre*. And they have an Instrument made to this Angle, which they call the *Mitre Square*; with which they strike Mitre-Lines on their Quarters or Battens; and for Dispatch they have a *Mitre-Box*, as they call it, which is made of two Pieces of Wood, each about an Inch thick, and one is nailed upright upon the Edge of the other; the Upper Piece hath the Mitre Lines struck upon it on both Sides, and a Kerf to direct the Saw in cutting the Mitre Joints readily, by only applying the Piece into this Box.

MIX'D-LINED FIGURE, is one consisting of Straight and Crooked Lines.

MIX'D NUMBER, is one that is Part integer, or a whole Number, and part of a Fraction; as $4\frac{1}{2}$, $10\frac{1}{2}$, &c.

MIX'D RATIO, or PROPORTION, is when the Sum of the Antecedent and Consequent is compared with the Difference between Antecedent and Consequent, as if $a : b :: c : d$. Then

$$a + b : a - b :: c + d : c - d.$$

MOAT, in Fortification, is a hollow Space or Ditch dug round a Town or Fortress which is to be defended; wherefore, the Length and Breadth often depends upon the Nature of the Soil, according as it is marshy or rocky: But Moats in general may be from sixteen to twenty two Fathom broad, and from

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fifteen to twenty five Foot deep.

Dry Moat, is that which is destitute of Water, and ought to be deeper than one that is full of Water.

Lined Moat, is that whose Scarp and Counterscarp are cased with a Wall of Masons-Work lying in Talus, or a Sloap.

Flat-bottom'd Moat, is that which hath no Sloping, its Corners being somewhat rounded. All Moats must be well flanked, and in general so wide, as that no Ladder, Tree, &c. can reach a-cross them. If the Ditch be dry, or has but little Water, there is usually another small Trench cut quite along the Middle of it.

MODEL, in Architecture. See *Model*.

MODES, in Musick. See *Mood*.

MODILLIONS, in Architecture, are little inverted Consoles under the Soffit or Bottom of the Drip, in the *Ionick*, *Composite*, and *Corinthian* Cornices, and ought to correspond to the Middle of Columns. These are particularly affected in the *Corinthian* Order, where they are always enrich'd with carved Works. In the *Ionick* and *Composite* they are more simple, having seldom any Ornaments, excepting sometimes a single Leaf underneath.

MODULE, in Architecture, is a little Measure, by which we mean any Bigness or Extent taken at Pleasure, to measure the Parts of a Building by, and is usually determined by the Lower Diameter of the Column and Pilasters. *Vignola's* Module, which is equal to the Semi-Diameter of the

the Column, is divided into twelve Parts in the *Tuscan* and *Dorick*, and into eighteen in the rest of the Orders. The Module of *Palladio*, *Scammozzi*, *M. De Cambray*, and *M. Desgodetz*, which is likewise equal to the Semi-Diameter, is divided into thirty Parts.

MOINEAU, is a Name the *French*, and some Modern Writers of Fortification, give to a little Plat-Bastion, which is raised before a Curtain that is too long, and which hath two other Bastions at the Ends of it; for they being out of Musket-Shot, one of the other, must be defended by some such Thing as this Moineau or Plat-Bastion.

Sometimes the Moineau joins to the Curtain, and sometimes is disjoined from it by a Moat.

MOMENTS, are sometimes taken for the least and most insensible Parts of Time; as when we say, such a Thing was done in a Moment.

1. In Mathematicks, Moments are such indeterminate and instable Parts of Quantity, as are supposed to be by perpetual Flux, *i.e.* either continually decreasing or increasing; which latter are taken for Affirmative and Positive Moments, and the former for Negative or Subtrahible ones. And these continually increasing or decreasing Particles are supposed to be infinitely small; for as soon as ever they come to be of any finite Magnitude, they cease to be Moments. Moments therefore are to be looked upon not as the Generative Principles of finite Magnitude; but to be inceptive only of them.

2. And because 'tis the same Thing, if in the Room of these

Moments, the Velocities of their Increases or Decreases be made use of, or the finite Quantities proportionable to such Velocities, this Method of Proceeding, which considers the Motion's Changings, or Fluxions of Quantities, hath come to be called *Fluxions*.

3. Moments, or *Momenta*, also in a Physical Sense, as they are used in reference to the Laws of Motion, signify the Quantities of Motion in any moving Bodies; and sometimes, simply the Motion itself; and they define it to be the *Vis insita*, or Power by which any moving Bodies do continually change their Places.

4. And in comparing the Motions of Bodies, the Ratio of these Moments is always compounded of the Quantity of Matter in, and the Celerity of the moving Body; so that the Moment of any moving Body may be consider'd as a Rectangle under the Quantity of Matter into the Celerity. And since 'tis certain, that all equal Rectangles have their Sides reciprocally proportionable; (*14 E. 6 Each.*) therefore, if the Moments of any Moveables are equal, the Quantity of Matter in one, to that of the other, will be reciprocally, as the Celerity of the latter to the Celerity of the former, and *vice versa*.

5. The Moments of any moving Body may be considered also as the Aggregate or Sum of all the Moments of the Parts of that Body; and therefore, where the Magnitudes and Number of any Particles are the same; and where they are moved with the same Celerity, there will be the same Moments of the Wholes.

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6. M. Leibnitz, Huygens, Bernouli, Wolfe, and some other Foreigners, have all been drawn into an horrid Error concerning the *Momenta*, or Force of falling Bodies: For they say, that the Forces of falling Bodies, at the Ends of the Fall, are not as the Velocities into the Quantities of Matter; but as the Squares of the Velocities into the Quantities of Matter. And all the Proof of this, by Experience, is a fallacious one, of suspending Balls by Threads to the Ceiling over Vessels of congealed Tallow, Clay, Wax, or any other yielding Substance; and then letting the Balls fall, and make Pits in the yielding Substance; for when the Balls were equal, and one weigh'd one Pound, and the other two, and the lighter Ball hung twice the Height of the other from the Surface of the Tallow; yet they made Pits in the Tallow of the same Depth: And from this Experiment they would have their *Momenta* to be equal, and consequently their proper Weights are in the Reciprocal Ratio of the Spaces which the said Bodies describe by their Fall; and because these Spaces are in the same Ratio, as the Squares of the Velocities; therefore, the Force of a falling Body is as the Body itself into the Square of the Velocity at the End of the Fall.

7. M. s'Gravesande, in his *Institutiones Philosophiæ Newtonianæ*, contradicts himself about this Matter; for he says, Pag. 75. *Dum pressione corpus acceleratur, manente equali pressione in corpus agentis, non augetur celeritas equaliter.* And therefore, according to this, if I take him right, the

Motion of a Body that falls freely short Spaces, is not accelerated equally in equal Times: And so the Celerity which is acquired in the Fall, is not as the Time in which the Body has fallen; and consequently the Spaces gone thro' from the Beginning of the Fall, will not be to one another, as the Squares of the Times or Velocities in which the Body fell; and yet in the Experiments, that he and *Polenus* has made to prove, that the Forces of falling Bodies are as the Matter into the Square of the Velocity. This new Proposition follows from the Spaces gone thro' by the Fall of Bodies, being as the Squares of the Times.

8. See concerning this in the *Acta Eruditorum*, An. 1686. p. 161. *Histoire des Ouvrages des Sçavans*, An. 1690. p. 451. *Journal Littéraire*, Tom. XII. p. 1, and 190. *Polenus*, in *Libro de Castellis*, &c. But Dr. *Desaguliers* has shewn them all to be false in this Point, in the *Philosophical Transaction*, N° 375, 376.

MONADES. See *Digits*.

MONOCHORD, a Kind of Instrument antiently of singular Use for the regulating of Sounds: But some appropriate the Name of Monochord to an Instrument that hath only one single String, as the Trumpet-Marine.

The Antients made use of the Monochord to determine the Proportion of Sounds to one another; when the Chord was divided into two equal Parts, so that when the Terms were as 1 and 1, they call them *Unisons*; but if they were as 2 to 1, they call them *Octaves*, or *Diapasons*; when they were as 3 to 2, they called them *Fifths*, or *Diapentes*; if they

if they were as 4 to 3, they call them *Fourths*, or *Diatefferons*; if the Terms were as 5 to 4, they call it *Diton*, or *Tierce-Major*; but if the Terms were as 6 to 5, then they called it a *Demi-Diton*, or a *Tierce-Minor*; and lastly, if the Terms were as 24 to 25, they called it a *Demiton*, or *Dieze*.

The Monochord being thus divided, was properly that which they called a *System*, of which there were many Kinds, according to the different Divisions of the Monochord.

MONOTRIGLYPH, a Term in Architecture, signifying the Space of one Triglyph between two Pilasters, or two Columns.

MOOD, in Musick, signifies certain Proportions of the Time, or Measure of Notes. These Moods or Modes, of measuring Notes, were formerly four in Number, viz.

1. *The Perfect of the More*, in which a Large contained three Longs, or a Long three Breves, a Breve three Semi-Breves, and a Semi-Breve three Minims.

2. *The Perfect of the Less*, where in a Large comprehended two Longs, a Long two Breves, a Breve three Semi-Breves, and a Semi-Breve two Minims.

3. *The Imperfect of the More*, in which a Large contained two Longs, a Long two Breves, a Breve two Semi-Breves, and a Semi-Breve three Minims.

4. *The Imperfect of the Less*, is the same with that which we call the *Common Mood*, the other three being now altogether out of use; altho' the Measure of our common Triple-Time is the same with the Mood *Imperfect of the More*, except that we reckon but two Minims to a Semi-Breve,

which in that Mood comprehended three. In our common Mood, two Longs make one Large, two Breves a Long, two Semi-Breves a Breve, &c. proceeding in the same Order to the last or shortest Note: So that a Large contains two Longs, four Breves, eight Semi-Breves, sixteen Minims, thirty two Crotchets, sixty four Quavers, &c.

Besides these Moods of Time, five others relating to Tune, were in use among the antient *Grecians*, which were termed Tones or Tunes by the *Latins*; the Design of either being to shew in what Key a Song was set, and how the different Keys had relation one to another.

These Sorts of Moods were distinguished by the Names of the several Provinces of *Greece*, where they were first invented; as the *Dorick*, *Lydian*, *Ionick*, *Phrygian*, and *Æolick*.

Dorick Mood consisted of slow-tuned Notes, and was proper for the exciting Persons to Sobriety and Piety.

Lydian Mood was likewise used in solemn Grave Musick; and the Descant or Composition was of slow Time, adapted to sacred Hymns or Anthems.

Ionick Mood was for more light and soft Musick; such as pleasant amorous Songs, Sarabands, Courants, Jiggs, &c.

Phrygian Mood was a warlike Kind of Musick, fit for Trumpets, Hautboys, and other Instruments of the like Nature, whereby the Minds of Men were animated to undertake Military Atchievements, or Martial Exercises.

Æolick Mood, being of a more airy, soft, and delightful Sound,

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such as our Madrigals, served to allay the Passions by the Means of its grateful Variety, and melodious Harmony.

These Moods or Tones were distinguished into Authentick and Playal, with respect to the dividing of the *Octave* into its *Fifth* and *Fourth*.

The former was when the Fifth possessed the Lower Place, according to the Harmonical Division of an *Octave*; and the other was when it stood in the Upper Place, according to the Arithmetical Division of the same *Octave*.

MONTH, properly speaking, is the Time in which the Moon runs through the *Zodiack*, and therefore is accounted by the Motion of the Moon: And so the *Lunar* Month is either Periodical, which is the Time of the Moon's Motion from any one Point of the *Zodiack* to the same again, and is something less than 27 Days and eight Hours; or else Synodical, which is the Time between New Moon and New Moon, and is something more than 29 Days and a half.

1. There is also a *Solar* Month, which is the Time that the Sun takes up running through one of the Signs of the *Zodiack*, and is almost 30 Days and a half.

2. And both these *Solar* and *Lunar* Months, are either Astronomical, like those abovementioned; or Civil, which are various, according to the Usage of accounting in different Places, Cities, and Nations.

3. The *Egyptians* accounted by *Solar* Months, each of 30 Days; and to compleat their

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Year, after 12 such Months, they added five Days, which the odd Hours made up.

4. But most of the antient Nations accounted by the *Lunar* Synodical Month; as the *Jews*, *Greeks*, and the *Romans*; till *J. Caesar's* Time; and as the *Mahometans* do to this Day. And because these Months did not contain an exact Number of Days, to adapt them to Civil Computation, they accounted alternately one Month to have 30, and the next 31 Days; and by this Means they made two such Civil Months to be equal to two *Lunar* ones of 29 Days and a half: and they brought it to pass, that the New Month, for a Run of many Years, did not much deviate from the first Day of the Civil Month.

MOON. The Periodical Revolution of the Moon, in reference to the fixed Stars, is 27 Days, seven Hours, 43 Minutes: And in the same Space of Time, by a strange Correspondence and Harmony of the two Motions, it revolves the same Way about its own Axis; whereby (one Motion converting it to, as the other turns it from the Earth) the same Side is always exposed to our Sight.

1. The Librations of the Moon's Body, which occasion that the same Hemisphere exactly is not always exposed to our Sight, arise from the Eccentricity of the Moon's Orbit, from the Perturbations by the Sun's Attraction, and from the Obliquity of the Axis of the Diurnal Rotation of the Moon's own Orbit, without the Knowledge of which Circumstances, her Phenomena

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were inexplicable ; but by the Consideration of them are very démonstrable.

2. The mean Horary Motion of the Moon, in respect of the fixed Stars, is 32 Minutes, 56 Seconds, 27 Thirds, 12 Fourths and a half.

3. The Moon is distant from the Earth according to most Astronomers, 59 : According to *Vindeline*, 60 : *Copernicus* $60\frac{1}{3}$: *Kircher* $60\frac{1}{2}$: And according to *Tycho*, $56\frac{1}{2}$ Semi-Diameters of the Earth. *Sir Isaac Newton* thinks the Distance ought to be esteem'd about 61. Therefore the mean Distance may be reckon'd 60.

4. She is nearer the Earth at her Syzygy, than in the Quadrature by $\frac{1}{69}$ th Part of the Distance.

5. According to Mr. *Cassini*, the Moon's greatest Distance from the Earth is 61, the mean Distance 56, and the least Distance 52 Semi-Diameters of the Earth.

6. The Power of the Moon's Influence as to the Tides, is to that of the Sun as $6\frac{1}{3}$ to one. *Sir Isaac Newton*.

7. As to the Inequality of the Moon's Motion, (which proceeds from the Actions of the Sun, disturbing the Motion of the secondary Planets) she moves swifter, and describes (by a Radius drawn from it to the Earth) a greater Area in Proportion to the Time, hath an Orbit less curved, and by that Means comes nearer to the Earth in her Syzygies or Conjunctions, than in the Quadratures, unless the Motion of her Eccentricity hinders it: Which Eccentricity is the greatest, when the *Apogæum* of the Moon happens in the Conjunction ; and is least, when the

Apogæum happens at the Quadratures ; and her Motion is swifter also in the Earth's *Aphelion*, than in its *Perihelion*. The *Apogæum* also goes forward swifter in the Conjunction, and goes slower at the Quadratures ; but her Nodes are at rest in the Conjunctions, and do recede most swiftly in the Quadratures.

8. The Moon also perpetually changes the Figure of her Orbit, or the Species of the Ellipsis she moves in.

9. There are also some other Inequalities in the Motion of this Planet, which can hardly be reduced to any certain Rule : As the Velocities or Horary Motions of the *Apogæum* and Nodes, and their Equations, and the Difference between the greatest Eccentricity in the Conjunctions, and the least in the Quadratures ; and that Inequality which is called the *Variation of the Moon* : All these do increase and decrease annually, in a Triplicate Ratio of the Apparent Diameter of the Sun : And this Variation is increased and diminished in a Duplicate Ratio of the Time between the Quadratures ; as *Sir Isaac Newton* proves in many Places of his *Principia*.

10. That curious Person found the *Apogæum* in the Moon's Syzygies to go forward 23 min. each Day, in respect of the fixed Stars ; and to go backward 16 min. $\frac{1}{3}$ each Day in the Quadratures : And therefore the middle annual Motions he estimates at 40 deg.

11. That the Cause of the Secondary Light of the Moon, as they call it, that is, the obscure Part of her appearing like kindled

Ashes, just before and after the Change of the New Moon, is the Sun's Rays reflected from the bright Hemisphere of the Earth to those dark Parts of the Moon; and thence again reflected to the Earth destitute of the Sun's Light.

12. Sir Isaac Newton makes it a Proposition to enquire into the Figure of the Moon; and supposing it, at its first Original, to have been a Fluid, like to our Sea, he calculates, that the Attraction of our Earth would raise the Water there to near 90 Foot high, as the Attraction of the Moon raiseth our Water to 12 Foot: Whence the Figure of the Moon must be a Spheroid, whose greatest Diameter extended, will pass through the Centre of our Earth; and will be longer than the other Diameter perpendicular to it, by 180 Foot; and from hence it comes to pass, that we see always the same Face of the Moon: For she cannot rest in any other Position, but will continually endeavour to conform herself to this Situation, *Prop. 38. Lib. III.*

13. Mr. Azout says, that this Planet's Diameter never appear'd to him above 33 min. and never less than 24 min. 45 sec.

14. Sir Isaac Newton reckons the mean Diameter of the Moon to be 32 min. 12 sec. as the Sun's is 31 min. 27 sec.

15. The Density of the Moon he concludes to be to that of the Earth, as 9 to 5 nearly; and that the Mass or Quantity of Matter in the Moon to that of the Earth, is as 1 to 26 nearly.

16. The Plane of the Moon's Orbit is inclin'd to that of the Ecliptick, and makes with it an

Angle of about five Degrees; and its Declination varies, and is greatest when the Moon is in the *Quadratures*, and least when she is in her *Syzygies*.

17. By means of the Spots in the Moon, the Lunar Ellipses are more accurately observed than formerly, to the great Advancement of Geography and Navigation in settling the Longitudes of Places; for the Immersion and Emergences of these Spots from the Shadow of the Earth, are most nicely determined.

18. Although the Moon's Period round the Earth be in 27 Days, seven Hours, and three Quarters, (which is the Periodical Month) yet because in the Space of a Periodical Month, the Earth also with its Satellite, the Moon is moved on almost an entire Sign; in consequence therefore the Point of the Moon's Orbit, in the last Conjunction, or New Moon, will be gotten too far to the Westward; and therefore the Moon cannot come yet to a new Conjunction with the Sun, but wants of it two Days and five Hours; which must be pass'd before the entire Lunation will be over, and before the Moon hath exhibited all her Phases. These two Days, and five Hours therefore being added to the Periodical Month, make the Synodical one, which consists of 29 Days, 12 Hours, and three Quarters.

19. The Moon disturbs the Motion of the Earth, and the common Centre of Gravity of those Bodies describe that Orbit about the Sun, which we have hitherto said that the Earth described; because we overlook'd the

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the Action of the Moon; but the Earth describes an irregular Curve.

20. The Gravity of the Moon towards the Earth, and this Gravity is increased by the Action of the Sun, when the Moon is in the *Quadratures*; and it is an Augmentation or Addition to the Gravity of the Earth towards the Sun.

21. The Earth's Distance from the Sun remaining the same, the abovemention'd Addition of Gravity increases and diminishes in the Ratio of the Distance of the Moon from the Earth.

22. The Distance of the Earth from the Sun remaining the same, the Gravity of the Moon towards the Earth decreases more slowly in the *Quadratures*, than according to the inverse Ratio of the Square of the Distance from the Centre of the Earth.

23. The Force which diminishes the Gravity of the Moon in the *Syzygies*, is double that which increases it in the *Quadratures*.

24. In the *Syzygies*, the disturbing Force is directly as the Distance of the Moon from the Earth, and inversely as the Cube of the Distance of the Earth from the Sun.

25. At the *Syzygies* the Gravity of the Moon towards the Earth, receding from its Centre, is more diminished, than according to the inverse Ratio of the Square of the Distance, from that Centre.

26. In the Motion of the Moon from the *Syzygies* to the *Quadrature*, the Gravity of the Moon towards the Earth is continually increased, and the Moon is con-

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tinually retarded in its Motion: But in the Motion from the *Quadrature* to the *Syzygy*, every Moment the Moon's Gravity is diminished, and its Motion in its Orbit is accelerated.

27. As the Radius is to the Sine, and an half of double the Distance of the Moon from the *Syzygy*, so the Addition of Gravity in the *Quadratures*, is to the Force which accelerates or retards the Moon in its Orbit.

28. And the Radius is to the Sum or Difference of one and a half, the Co-Sine of double the Distance of the Moon from the *Syzygy*, and half the Radius; as the Addition of Gravity in the *Quadratures*, to the Diminution or Increase of Gravity in that Situation of the Moon, concerning which the Computation is made.

29. The Moon is less distant from the Earth at the *Syzygies*, and more at the *Quadratures*.

30. In the *Quadratures* and *Syzygies*, the Moon describes *Area's* by Lines drawn to the Centre of the Earth, proportional to the Times.

31. The *Area's*, by Lines drawn to the Centre of the Earth, are not exactly proportional to the Times at all Times.

32. The Apfides of the Moon go forward, when the Moon is in the *Syzygies*: In the *Quadratures*, the Apfides go backwards, that is, move in *Antecedentia*.

33. The Progress, considering one entire Revolution of the Moon, exceeds the Regress, *Ceteris Paribus*.

34. The Apfides go forward fastest of all in a Revolution of the Moon, supposing the Line of the Apfides in the Nodes; and in

that very Case they go back the slowest of all in the same Revolution.

35. Supposing the Line of the Apfides to be in the *Quadratures*, the Apfides are carried in *Consequentia*, the least of all in the *Syzygies*; but they return the swiftest in the *Quadratures*; and in this Case, in one entire Revolution of the Moon, the Regress exceeds the Progress.

36. The Excentricity of the Orbit, every Revolution, undergoes various Changes. It is the greatest of all, when the Line of the Apfides is in the *Syzygies*; but the Orbit is the least Excentrick of all, when the Line of the Apfides is in the *Quadratures*.

37. The Ratio between the Addition of Gravity in the *Quadratures*, and the Force, which removes the Moon out of its Orbit, is the Ratio of the Cube of the Radius to three Times the Product of the Sines of the Distances of the Moon from the *Quadrature*, and of the Node from the *Syzygy*; as also of the Inclination of the Plane.

38. This Force is increased as the Moon advances towards the *Syzygy*, and as the Nodes recede from it.

39. Considering one entire Revolution of the Moon, *Ceteris Paribus*, the Nodes move in *Antecedentia* swiftest of all, when the Moon is in the *Syzygies*; then slower and slower, till they are at rest, when the Moon is in the *Quadratures*.

40. The Line of Nodes does successively acquire all possible Situations in respect of the Sun; and every Year goes twice thro' the *Syzygies*, and twice thro' the *Quadratures*.

39. If we consider several

Revolutions of the Moon, the Nodes in one whole Revolution go back very fast, the Nodes being in the *Quadratures*; then slower, till they come to rest, when the Line of Nodes is in the *Syzygies*.

40. By the same Force with which the Nodes are moved, the Inclination of the Orbit is also changed; it is increased as the Moon recedes from the Node, and diminished as it comes to the Node.

41. When the Nodes are come to the *Syzygies*, the Inclination of the Plane of the Orbit is the least of all; for in the Motion of the Nodes from the *Syzygies* to the *Quadratures*, and in one whole Revolution of the Moon, the Force which increases the Inclination exceeds that which diminishes it; therefore the Inclination is increased, and it is the greatest of all, when the Nodes are in the *Quadratures*.

42. All the Errors in the Moon's Motion are something greater in the Conjunction than in the Opposition.

43. All the disturbing Forces are inverfly, as the Cube of the Distance of the Sun from the Earth, which when it remains the same, they are as the Distance of the Moon from the Earth. Considering all the disturbing Forces together, the Diminution of Gravity prevails.

44. The Motion of the Moon being considered in general. The Gravity of the Moon towards the Earth is diminished coming near the Sun, the Periodical Time is the greatest; as also the Distance of the Moon (*Ceteris Paribus*) the greatest, when the Earth is in the *Perihelion*.

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MORTAR-PIECE, is a kind of very short Piece of Cannon, or Ordnance, thick and wide, proper for the discharging of Bombs, Carcasses, Stones, &c. It is usually mounted on a Carriage, the Wheels whereof are very low.

Mr. Anderson's TABLE of the requisite Weight of Powder for all Mortars, from 6 to 20 Inches Diameter.

| Inch. | Decem. | Pounds. | Ounces. |
|-------|--------|---------|------------------|
| 6. | 0 | 0. | 13 |
| 6. | 5 | 1. | 01 |
| 7. | 0 | 1. | 05 |
| 7. | 5 | 1. | 10 |
| 8. | 0 | 2. | 00 |
| 8. | 5 | 2. | 06 |
| 9. | 0 | 2. | 14 |
| 9. | 5 | 3. | 06 |
| 10. | 0 | 3. | 14 $\frac{1}{2}$ |
| 10. | 5 | 4. | 08 |
| 11. | 0 | 5. | 03 |
| 11. | 5 | 5. | 15 |
| 12. | 0 | 6. | 12 |
| 12. | 5 | 7. | 10 |
| 13. | 0 | 8. | 09 |
| 13. | 5 | 9. | 10 |
| 14. | 0 | 10. | 11 $\frac{1}{2}$ |
| 14. | 5 | 11. | 14 |
| 15. | 0 | 13. | 03 |
| 15. | 5 | 14. | 09 |
| 16. | 0 | 16. | 16 |
| 16. | 5 | 17. | 09 |
| 17. | 0 | 19. | 03 |
| 17. | 5 | 20. | 15 |
| 18. | 0 | 22. | 12 $\frac{1}{2}$ |
| 18. | 5 | 24. | 11 |
| 19. | 0 | 26. | 13 |
| 19. | 5 | 28. | 14 |
| 20. | 0 | 31. | 04 |

MOTION, is a Continual and Successive Mutation of Place, and is either Absolute or Relative.

1. *Absolute Motion*, is the Change of the *Locus Absolutus* of any

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moving Body ; and therefore, its Celerity will be measured by the Quantity of the Absolute Space, which the Moveable Body hath run through. But,

2. *Relative Motion*, is a Mutation of the Relative or Vulgar Place of the moving Body, and so hath its Celerity accounted or measured by the Quantity of Relative Space which the Moveable Body runs over.

3. All Motion is of itself Recti-Linear, or made according to Straight Lines, with the same constant uniform Velocity ; if no external Cause makes any Alteration in its Direction.

4. If two Bodies, moving uniformly, go with unequal Velocities, the Spaces which will be pass'd over by them in unequal Times, will be to one another in a Ratio compounded of that of the Velocities, and that of the Times.

5. The Motions of all Bodies are as the Rectangles under the Velocities, and the Quantities of Matter.

6. The Motions of Bodies included in a given Space, among themselves, will not be changed by the Motion of that Space uniformly forwards in a Straight Line.

7. Every Body will continue in its State, either of Rest or Motion uniformly forward in a Right Line, unless it be made to change that State by some Force impressed upon it.

8. The Change of Motion is proportionable to the moving Force impressed, and is always according to the Direction of that Right Line, in which the Force is impressed.

9. The Quantity of any Motion is discoverable by the Joint-

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Consideration of the Quantity of Matter in, and the Velocity of the moving Body : For the Motion of any Whole, is the Sum of the Motions of all the Parts.

10. The Quantity of Motion, which is found, by taking either the Sum of Motions made the same Way, or the Difference of those which are made contrary Ways, is not at all changed by the Action of Bodies one upon another.

11. In all kind of Motions whatever, Rolling, Sliding, Uniform, Accelerated, or Retarded, in Right Lines, or in Curves, &c. the Sum of the Forces which produce the Motion of all Parts of its Duration, is always proportionable to the Sum of the Paths, or Lines, which all the Points of the moving Body describe.

12. The Product of the Duration of all uniform Motions, multiplied by the Force which began the Motion, is always proportionable to the Product made by the Path, or Line of Motion multiplied by the Mass or Quantity of Matter in the moving Body.

MOTION of the *Apogæum*, in the *Ptolemaick* System, is an Arch of the *Zodiack* of the *Primum Mobile*, contained between the Line of the *Apogæum*, and the beginning of *Aries*.

MOTION COMPOUNDED. See *Compound Motion*.

MOULDINGS. Under this Name are comprehended all those Jettings or Projections beyond the naked Wall, a Column, &c. which only serve for Ornament; whether they be square, round, straight, or crooked. Of these there are seven Kinds more considerable than the rest, *viz.* the

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Doucine, the *Taton*, or *Heel*, the *Ovolo*, or *Quarter-Round*, the *Plinth*, the *Astragal*, the *Denticle*, and the *Cavetto*.

MOVEMENT ; the same with what many do call an *Automaton*, and with us signifies all those Parts of a Watch, Clock, or any such curious Engine, which are in Motion, carry on the Design, or answer the End of the Instrument.

MOULINET, a *French* Term, signifying a Turn-Stile; 'tis used in Mechanicks, and signifies a *Roller*; which being crossed with two Levers, is usually applied to Cranes, Capstans, and other Sort of Engines of the like Nature, to draw Cords, and heave up Stones, Timber, &c. Also a kind of Turn-Stile, or wooden Cross, which turns horizontally upon a Stake fixed in the Ground, and is usually placed in Passages, to keep out Horses, and to oblige Passengers to go, or come one by one,

These Moulinets are often set up near the Out-Works of fortified Places, at the Side of the Barriers, through which People pass on Foot.

MOYENAU, (a *French* Term) in Fortification, is a small flat Bastion, commonly placed in the Middle of an over-long Curtain, by which the Bastions at the Extremities are not well defended from the Small-Shot, by reason of their Distance; so that this Work is proper for placing in it a Body of Musqueteers to fire upon the Enemy from all Sides.

MULTANGULAR FIGURE, is one that has many Sides and Angles.

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MULTILATERAL, in Geometry, are those Figures that have more than four Sides.

MULTINOMIAL ROOT. See *Polynomial*.

MULTIPLE PROPORTION, is when the Antecedent being divided by the Consequent, the Quotient is more than Unity; and the Reason of the Name is, because the Consequent must be multiplied by the Index, or Exponent of the Ratio, to make it equal to the Antecedent. Thus 12 is Multiple in proportion to 4, because being divided by 4, the Quotient is 3, which is the Denomination of the Ratio; and the Consequent 4 being multiplied by 3, makes the Antecedent 12; wherefore 3 is Sub-Multiple of 12.

MULTIPLE SUPER-PARTICULAR PROPORTION, is when one Number or Quantity contains another more than once, and such an Aliquot Part.

MULTIPLE SUPER-PARTIENT PROPORTION, is when one Number or Quantity contains another divers Times, and some Parts besides.

MULTIPLICATION, is, in general, the taken or repeating of one Number or Quantity as often as there are supposed Unites in the other Number: The Number multiplied, is called the *Multiplicand*; the Number multiplying, the *Multiplicator*; and that which is found or produced, is called the *Product*.

MULTIPLICATION, is only a compendious Addition, effecting at once, what in the ordinary Way of Addition would require many Operations: For the *Multiplicand* is only added to itself, or repeated, as often as the Unites

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of the *Multiplicator* do express it. Thus if 6 were to be multiplied by 4, the *Product* is 24, which is the Sum arising from the Addition of 6 four Times to itself.

In all Multiplication, as 1 is to the *Multiplicator*; so is the *Multiplicand* to the *Product*.

MULTIPICAND, in Arithmetick, is the Number to be multiplied.

MULTIPLICATOR, in Arithmetick, is the Number by which you multiply, or the Number multiplying.

MULTIPLIER, the same with *Multiplicator*.

MURDERERS, are small Pieces of Ordnance, either of Brass or Iron, having Chambers (that is, Charges made of Brass or Iron) put in at their Breeches: They are mostly used at Sea, at the Bulk-Heads of the Fore-castle, Half-Deck, or Steerage, in order to clear the Decks, when any Enemy boards the Ship; they are fasten'd and travers'd by a Pintle, which is put into a Stock.

MUSICK, is one of the seven Sciences, commonly called *Liberal*, and comprehended also among the Mathematical, as having for its Object discrete Quantity or Number; but not considering it in the Abstract, like Arithmetick; but with relation to Time and Sound, in order to make a delightful Harmony.

This Science is also Theoretical, which examineth the Nature and Properties of Concords and Discords, explaining the Proportions between them by Numbers: And Practical, which teacheth not only Composition, that

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that is, the Manner of Composing all Sorts of Tunes or Airs; but also the Art of Singing with the Voice, or Playing upon Musical Instruments.

MUSKET-BASKETS, in Fortification, are Baskets of about a Foot and a half high, and eight or ten Inches Diameter at the Bottom, and a full Foot at the Top: They are fill'd with Earth, and are set on low Parapets, or Breast-Works, or on such as are beaten down, that the Musqueteers may fire between them at the Enemy, and yet be tolerably well secured against their Fire.

MUTULE, in Architecture, is a kind of Square Modillon, set under the Cornice of the *Dorick* Order, and so called from the Word *Mutilus*, maimed or imperfect, because they represent the Ends of the Rafters, which are crooked or bent, in like manner, as the Beams or Joints are represented by the Triglyphs in the Frieze of the same Order.

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NADIR, is that Point of the Heavens seemingly under the Earth, which is diametrically opposite to the Point directly over our Head, viz. the *Zenith*; so that they are both as it were the Poles of the Horizon, and distant from it on each Side ninety Degrees, and consequently fall upon the Meridian, one above the other under the Earth; and whatever Distance one of them has from the Equator, and one of the Poles of the World,

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the same, on the contrary, has the other from the opposite Poles and adverse Part of the Equator.

NAPIERS, or NAPERES-BONES or RODS, are a kind of larger Multiplication-Table, contriv'd upon Four-square Wooden or Ivory Rods by the Lord *Neper*, for the more easy multiplying, dividing, and extracting the Roots of great Numbers.

NATURAL DAY. See *Day*.

NATURAL HORIZON; the same with *Sensible Horizon*.

NATURAL PHILOSOPHY, is the same with what is usually called *Physicks*, viz. that Science which contemplates the Power of Nature, the Properties of natural Bodies, and their mutual Actions one upon another.

NAVIGATION, is the Art of Sailing, whereby the Mariner is instructed how to guide a Ship from one Part to another, the shortest and safest Way, and in the shortest Time: And this is Two-fold, either

Improper, which is called *Coasting*, in which the Places are at no great Distance one from another, and the Ship sails usually in Sight of Land, and is within Soundings. Now, for the Performance of this, there is required a good Knowledge of the Lands, the Use of the Compass, the Lead, or Sounding Line, and such Books as *Rutters*, &c.

Proper, is where the Voyage is performed in the vast Ocean, out of sight of all Land; and here is necessary not only the Knowledge of the Lead, Compass, &c. But the Master must be a thorow Sailor or Artift, and understand well *Mercator's Charts*, *Azimuth*, and *Amplitude Compass*.

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Log-Line, and all good Instruments for Cœlestial Observations that can be used at Sea.

NAUTICAL CHART, the same as *Sea-Chart*.

NAUTICAL COMPASS, the same as *Sea Compass*.

NAUTICAL PLANISPHERE, is a Description of the Terrestrial Globe upon a Plane, for the Use of Mariners; and is either the *Plane Chart*, as they call it, where the Parallels of Latitude are all of the same Length with the Meridians; and which therefore is very erroneous, except in short Voyages, and near the Equator: Or *Mercator's Chart*, where the Meridians are increased in proportion, as the Parallels shorten, that is, as the Secants of the Arch contained between the Point of Latitude, and the Equator.

NEBULOUS STARS, are certain fixed Stars of a dull, pale, and obscurish Light. These seen through good Telescopes, appear to be Clusters of small Stars.

NEEDLE. See *Box and Needle*.

NEGATIVE QUANTITIES, in Algebra, are such as have before them the Negative Sign, and which are supposed to be less than nothing.

NEIPE TIDES, *written also NEPE or NEEP*, are those Tides (when the Moon is in the middle of the second and last Quarter) which are opposite to the Spring-Tides; and as the highest of the Spring-Tides is three Days after the Full or Change, so the lowest of the Neep is four Days before the Full or Change.

NEWEL, in Architecture, is the upright Post that the Case of Winding-Stairs turns round about.

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NICHE, in Architecture, is a Cavity left designedly in the Wall of a Building, to place a Statue in.

NOCTURNAL, is an Instrument made of Box, Ivory, or Brass, to take the Altitude or Depression of the Pole-Star, in respect to the Pole itself, in order to find the Latitude, and nearly the Hour of the Night.

1. There are several Sorts of Nocturnals, of which some may be Projections of the Sphere; such as the Hemispheres or Planispheres on the Plane of the Equinoctial; but the Seamen use only two, and the Manner of using either is the same. One of them is fixed for the *Pole-Star*, and first of the Gards of the *Little Bear*; and the other for the *Pole-Star*, and the Gards or Pointers (as some call them) of the *Great Bear*.

2. The Instrument consists of three Parts or Pieces; the largest of which hath a Handle to hold it by, when you would observe; and opposite to the Handle, there is a small Tooth or Point, which (if it be made for the *Little Bear*) stands against the 25th of *April*; but if for the *Great Bear* against the 17th of *February*, which are the Times of the Year when those Stars come to the Meridian at Twelve at Night. On this bigger Part or Piece there are two Circles described; the Outermost hath the Months and their Days, and the Innermost hath the 24 Hours of a Natural Day. On the Backside of this Piece also are 32 Points of the Compass designed and marked and their Initial Letters.

3. The second Part of the Nocturnal hath two Circles described on,

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on it; of which the Uttermoſt is divided into $29\frac{1}{2}$, equal Parts for the Days of the Moon's Age, and the Innermoſt into 24 Hours; and at the Beginning of the Days of the Moon's Age, and at Twelve, there is a Tooth to be ſet to the Day of the Month in the Upper Part.

4. The third Part is an Index with a fiducial Edge, iſſuing from the Centre; and muſt be ſo long, that a good Part of it may extend beyond the outermoſt or biggeſt Piece. Theſe three Parts are ſo order'd, that by means of a ſmall hollow Braſs Socket they are made to move about the Centre of the Inſtrument.

NOCTURNAL ARCH, is that Space in the Heavens which the Sun, Moon, or Stars, runs thro' parallel to the Equator, from their Setting to their Riſing.

NOCTURNABLE, is an Inſtrument uſed to find how much the North Star is higher or lower than the Pole at all Hours of the Night.

NODATED HYPERBOLA. So Sir *Iſaac Newton* calls a *Peculiar Kind of Hyperbola*, which by turning round decuſſates, or croſſes itſelf.

NODES, in Aſtronomy, are the Points of Interſection of the Orbit of the Sun, or any Planet, with the Ecliptick; ſo that the Point where a Planet paſſes over the Ecliptick, out of Southern into Northern Latitude, is called the *North* or *Ascending Node*: And where it deſcends from North to South, 'tis the *South* or *Descending Node*.

NODUS, or **NODE**, in Dialling, is a certain Point in the

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Axis or Cock of a Dial, by the Shadow of which, either the Hour of the Day in Dials without Furniture, or the Parallels of the Sun's Declination, his Place in the Ecliptick, the *Italian* or *Babylonish* Hours, &c. are ſhewn, in ſuch Dials as have Furniture.

NONAGESIMAL DEGREE, is the higheſt Point, or 90th Degree of the Meridian.

NONES of a Month, are the next Days after the Kalends, which is the firſt Day. In *March*, *May*, *June*, and *October*, the *Romans* accounted ſix Days of the Nones; but in all the reſt of the Months but four. They had this Name probably, becauſe they were always nine Days incluſively, from the firſt of the Nones to the Ides, *i. e.* reckoning incluſively both thoſe Days.

NORMAL, the ſame with *Perpendicular*, or at *Right Angles*; and 'tis uſually ſpoke of a Line, or a Plane that interſects another perpendicularly.

NORTHERN SIGNS of the Ecliptick or Zodiack, are thoſe ſix which conſtitute that Semi-Circle of the Ecliptick, which inclines to the Northward from the Equator; as *Aries*, *Taurus*, *Gemini*, *Cancer*, *Leo*, *Virgo*.

NOTES, in Muſick, are certain Terms invented to diſtinguiſh the Degrees of Sound, and the Proportion of Time belonging to it.

1. Theſe Notes relating to the Diſtinctions of Sound, are ſeven in Number, *viz.* *Gamut*, *Aire*, *Bemi*, *Cefaut*, *Gefolrate*, *Alamire*, *Befabemi*, *Cefolfant*.

2. And the Notes relating to Time, are nine in Number, *viz.* *Large*, *Long*, *Breve*, *Semi-Breve*,

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Breve, Minim, Crotchet, Quaver, Semi-Quaver, and Demi-Semi-Quaver.

3. But the *Large* and *Long* are now of little Use, as being too long for any Voice or Instrument (the Organ only excepted) to hold out to their full Length; although their Rests are still very often used, more especially in Grave Musick, and Songs of many Parts.

NUCLEUS, is by *Hewelius* and others used for the Head of a Comet, and by others for the Central Parts of any Planets.

NUCLEUS, in Architecture, is the middle Part of the Flooring of the Antients, consisting of Cement, which they put betwixt a Lay, or Bed of Pebbles, cemented with Mortar made of Lime and Sand.

NUMBER, is whatever is reffer'd to Unity; or it is a Collection of Units, and is that which teacheth us to know how many any of the Objects of our Knowledge are.

NUMERAL ALGEBRA, is that which makes use of Numbers instead of Letters of the Alphabet.

NUMERATION, in Arithmetick, is the true Distinction, Estimation, and Pronunciation of Numbers, or the Rule to read any Number, tho' never so great, and to have a distinct Idea of each Place or Figure of it.

NUMERATOR of a *Fraction*, is that Part of it which shews or numbers how many of those Parts which any Integer is supposed to be divided into, are expressed by the Fraction. Thus in $\frac{6}{8}$, 6 is the Numerator, (which stands always above the Line) and shews you, that if any

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Whole be divided into 8 Parts; you number and enumerate, or take 6 of them, i.e. three Quarters.

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OBELISK, in Architecture, is a kind of Quadrangular Pyramid, very tall and slender, raised in a publick Place, to shew the Largeness of some enormous Stone, or to serve as a Monument of some memorable Transaction.

OBJECT-GLASS, of a Telescope or Microscope, is that Glass which is placed at that End of the Tube, which is next the Object.

OBJECTIVE-LINE. See *Line-Objective*.

OBLIQUE ANGLES. See *Angles Oblique*.

OBLIQUE ASCENSION, is that Degree and Minute of the Equinoctial, which riseth with the Centre of the Sun or Star, or with any Point of the Heavens, in any Oblique Sphere.

OBLIQUE CIRCLE, in the Stereographical Projection of the Sphere, is any Circle that is Oblique to the Plane of Projection.

OBLIQUE DESCENSION, is that Part of the Equinoctial which sets with the Sun or Star, or with any Point of the Heavens, in an Oblique Sphere.

OBLIQUE FORCE, is that whose Line of Direction is not at Right Angles with the Body on whom it is impress'd. The Ratio which such an *Oblique Force*, to move a Body, bears to a direct or perpendicular Force will be

as the Sine of the Angle of Incidence is to the Radius.

OBLIQUE PLAINS, in Dialling, are such as recline from the Zenith, or incline to the Horizon.

OBLIQUE SAILING, is the Application of the Method of calculating the Parts of Oblique Plane Triangles, in order to find the Distance of a Ship from any Cape, Head-Land, &c.

OBLIQUE SPHERE, is where the Pole is elevated any Number of Degrees less than 90 Degrees, and consequently the Axis of the World, the Equator, and Parallels of Declination, will cut the Horizon obliquely.

OBLONG, in Geometry, is the same with a Rectangle Parallelogram, whose Sides are unequal.

OBSCURA CAMERA. See *Camera Obscura*.

OBSERVATION. The Seamen call an Observation the taking the Sun or any Star's Meridian Altitude, in order thereby to find their Latitude; and how they do this, you will find under that Word: And they call finding the Latitude, by the Name of *Working an Observation*.

OBTUSE ANGLES. See *Angles*.

OBTUSE ANGULAR Section of a Cone. So the antient Geometers, called that *Conick Section*, which since, by *Apollonius*, is called the *Hyperbola*, because they considered it only in such a Cone, whose Section by the Axis is a Triangle, obtuse-angled at the Vertex.

OBTUSE-ANGLED TRIANGLE, is one that has an Obtuse-Angle.

OCCIDENT, is the West Quarter of the Horizon; or 'tis that Part of the Horizon, where the

Ecliptick, or the Sun therein descends into the Lower Hemisphere: In some Books you will meet with such Terms.

OCCIDENT ESTIVAL, is that Point of the Horizon, where the Sun sets at its Entrance into the Sign *Cancer*, when the Days are longest.

OCCIDENT EQUINOCTIAL, is that Point of the Horizon, where the Sun sets, when it enters *Aries* or *Libra*.

OCCIDENT HYBERNAL, is that Point of the Horizon, where the Sun sets, when it enters into the Sign of *Capricorn*, at which Time the Days (with us) are shortest.

OCCIDENTAL, (*i. e. Westward*) in Astronomy, a Planet is said to be Occidental, when it sets after the Sun.

OCCULATION, in Astronomy, is the Time that a Star or Planet is hid from our Sight, when eclipsed by the Interposition of the Body of the Moon, or some other Planet between it and us.

OCEAN, is by Geographers taken for that great Collection of Waters, or Large Sea, which compasses in the whole Earth, and into which the other Lesser Seas do usually run.

1st, This great and universal Ocean, is sometimes by Geographers divided into three Parts. As, 1. The *Atlantick* and *European* Ocean, lying between Part of *Europe*, *Africa*, and *America*. 2. The *Indian* Ocean, lying between *Africa*, the *East-Indian* Islands and *New-Holland*. 3. The great *South-Sea*, or the *Pacifick* Ocean, which lies between the *Philippine* Islands, *China*, *Japan*, and *New-Holland* on the West, and the Coast of *America* on the East.

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adly, The Surface of the whole Ocean, or of all the Seas of the Globe, Mr. *Keil* computes in his Examination of Dr. *Burnet's Theory of the Earth*, to be 85490506 Squares Miles, and therefore supposing the Depth to be a Quarter of a Mile, the Quantity of Water in the Whole is 21372626 $\frac{1}{2}$ Cubick Miles.

OCTAGON, in Geometry, is a Figure of eight Sides and Angles: And this, when all the Sides and Angles are equal, is called a *Regular Octagon*, or one which may be inscrib'd in a Circle.

If the Radius of a Circle circumscribing a Regular Octagon be $=r$, and the Side of the Octagon $=y$. Then $y = \sqrt{2r - r\sqrt{2}}$.

Every Regular Octagon is a mean Proportional between the circumscribing and the inscrib'd Square.

OCTAHEDRON, is one of the Regular Solids, consisting of eight equal and equilateral Triangles.

The Square of the Side of the *Octahedron*, is to the Square of the Diameter of the circumscribing Sphere, as 1 to 2.

If the Diameter of the Sphere be 2, the Solidity of the *Octahedron* inscrib'd in it will be 1,33333.

OCTAVE, or EIGHTH, in Musick, is an Interval of eight Sounds; every Eighth Note in the Scale of the Gamut being the same, as far as the Compass of Musick requires.

OCTOSTYLE, in Architecture, is the Face of an Edifice adorn'd with eight Columns.

OGEE. See *Cima*.

OPACOUS BODIES, are those thro' which the Rays of Light have no Admission.

Sir *Isaac Newton* in his *Opticks*, Book II. shews, That the Opacity of all Bodies ariseth from the Multitude of Reflexions caused in their Internal Parts: And he shews also, that between the Parts of the Opaque, and coloured Bodies, there are many Spaces, either empty or replenished with Mediums of ether Densties; and he shews the true or principal Cause of Opacity to be this Discontinuity of their Parts; because some Opaque Bodies become transparent by filling their Pores with any Substance of equal Density with their Parts.

OPEN FLANK, in Fortification, is that Part of the Flank which is covered by the Shoulder or Orillion.

OPENING of the Trenches, is the first breaking Ground of the Besiegers, in order to carry on their Attacks against the Town.

OPHINEUS. One of the Northern Constellations, containing thirty Stars.

OPPOSITE ANGLES. See *Angles*.

OPPOSITE CONES, are two Similar Cones, as *A, B*, having the same common Vertex *G*, and also the same Axis.

OPPOSITE SECTIONS, are the Hyperbola's *D, C*, made by cut-



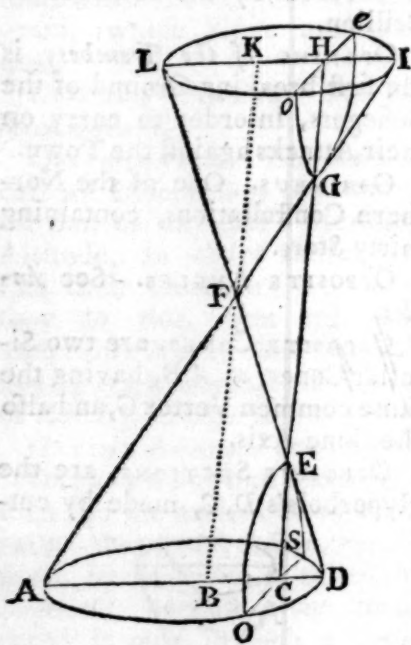
ting

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ting the Opposite Cones A, B ,
by the same Plane. These Hy-
perbola's are always equal and
similar.

If the Opposite Superficies be cut by a Plane making the opposite Hyperbola's (or Sections) *OES*, *oGe*: I say, both those Hyperbola's will be perfectly alike and equal.

Let AED be the Triangle passing thro' the Axis at Right Angles to the Plane of the Hyperbola OES , and suppose LEI to be a Triangle in the same Plane as the Triangle AED . This shall pass thro' the Axis of the opposite Cone, and will cut the Hyperbola oGe at Right Angles. Let AD , and LI , be



parallel common Sections of those Triangles, and the Bases of the opposite Cones. Draw the Right Line KFB thro' the Vertex F , in the Plane of the Triangles, parallel to the common

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Diameter *GE* of the Opposite Sections. Now, our Business is to prove, that $LH \times HI (= \overline{OH}^2) : AC \times CD (= \overline{OC}^2) :: HE \times GH : GC \times EC$.

Because the Triangles ABF , ACG , and DBF , DCE , are similar. Therefore $AB : BF :: AC : CG$, $BD : BF :: CD : EC$, $AB \times BD :: BF^2 : AC \times CD : CG \times EC$, by multiplying the Antecedents and Consequents of both Proportions by each other.

Again, because the Triangles ABF , IHG , and BDF , HLE are similar, therefore $AB:BF::HI:HG$, $BD:BF::LH:HE$. And so multiplying the Antecedents and Consequents of both the Proportions by one another, and you will have $AB \times BD : BF^2 :: HI \times LH : HG \times HE$. But it was prov'd before that $AB \times BD : BF^2 :: AC \times CD : CG \times EC$. Therefore $HI \times LH : HG \times HE :: AC \times CD : CG \times EC$, and so $HI \times LH : AC \times CD :: HG \times HE : CG \times EC$.

OPPOSITION, is that Position or Aspect of the Stars or Planets, when they are 6 Signs, or 180 Degrees distant from one another, and is marked thus, \odot .

OPTICKS, taken properly and simply, is that Science which teaches the Properties of a direct Vision; but in a larger Sense it may comprehend the whole Doctrine of Light and Colours, and all the Phenomena of visible Objects.

OPTICK PLACE of a *Star* or *Planet*, is that Point or Part of its Orbit, which is determined by our Sight, when the Star is there; and this is either true, when the Observer's Eye is supposed to be at the Centre of the **Earth**

Earth or Planet he inhabits ; or apparent, when his Eye is at the Circumference of the Earth.

ORB, is only a hollow Sphere.

ORBIS MAGNUS, is the Orbit of the Earth in its Annual Revolution round the Sun.

All the Antients, and the Astronomers before the great *Kepler* supposed this Orbit to be a perfect Circle ; but he proves it to be an Ellipsis ; the remotest End of whose longer or transverse Diameter is eight Signs, and eight Degrees distant from the first Star in *Aries*, and having the Sun in one of its Focal Points.

ORBIT of any Planet, is the Curve that it describes, about the Sun.

The Orbits of all the Planets are Ellipses, having the Sun in their common Focus : But the Elliptick Orbit of the Earth, by the Action of the Moon, is sensibly disfigur'd ; as also the Orbit of *Saturn*, by the Action of *Jupiter*, when they are in Conjunction.

ORDER, in Architecture, is a particular Arrangement of Proportions ; or 'tis a certain Rule for the Proportions of Columns, and for the Figures which some of the Parts ought to have on Account of the Proportions that are given them. There are six, viz. the first, the *Tuscan Order*, *Doric Order*, *Ionick Order*, *Corinthian Order*, *Composite Order*, and the *Attick Order*.

ORDER of Curve-Lines. Sir *Isaac Newton*, in his *Fragmenta Epistoliarum*, gives an Enumeration of Geometrical Lines of the third Order, as thus :

1. Geometrick Lines, are best

distinguished into Classes, Genders, or Orders, according to the Number of the Dimensions of an Equation, expressing the Relation between the Ordinates and the Abscissæ ; or, which is much at one, according to the Number of Points, in which they may be cut by a Right Line ; wherefore, a Line of the first Order will be only a Right Line : Those of the *Second*, or *Quadratick Order*, will be the Circle and the Conick-Sections ; and these of the *Third*, or *Cubick Order*, will be the Cubical and *Nelian Parabola's*, the Cissoid of the Antients, &c. But a Curve of the First Gender (because a Right Line cannot be reckon'd among Curves) is the same with a Line of the *Second Order* ; and a Curve of the Second Gender, the same with a Line of the *Third Order* ; and a Line of an infinitesimal Order, is that which a Right Line may cut in infinite Points, as the Spiral, Cycloid, the Quadratrix, and every Line generated by the infinite Revolutions of a Radius.

2. The chief Properties of the Conick-Sections are every where treated of by Geometers ; and of the same Nature are the Properties of the Curves of the Second Gender, and of the rest ; as from the following Enumeration of their principal Properties will appear.

3. For, if any Right and Parallel Lines be drawn and terminated on both Sides by one and the same Conick-Section ; and a Right Line bisecting any two of them, shall bisect all the rest ; and therefore, such a Line is called the *Diameter of the Figure* ;

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and

and all the Right Lines so bisected, are called *Ordinate Applicates* to that Diameter; and the Point of Concourse to all the Diameters, is called the *Centre of the Figure*; as the Intersection of the Curve, and of the Diameter, is called the *Vertex*, and that Diameter the *Axis* to which the Ordinates are normally applied: And so in Curves of the Second Gender; if any two Right and Parallel Lines are drawn occurring to the Curve in three Points, a Right Line which shall cut those Parallels, so that the Sum of two Parts terminated at the Curve on one Side of the Intersecting Line shall be equal to the third Part terminated at the Curve on the other Side. This Line shall cut, after the same Manner, all others parallel to these, and occurring to the Curve in three Points; that is, shall so cut them, that the Sum of the two Parts on one Side of it, shall be equal to the third Part on the other.

And therefore, these three Parts, one of which is thus every where equal to the Sum of the other two, may be called *Ordinate Applicates* also: And the Intersecting Line, to which the Ordinates are applied, may be called the *Diameter*; the Intersection of the Diameter and the Curve, may be called the *Vertex*, and the Point of Concourse of any two Diameters, the *Centre*.

And if the Diameter be Normal to the Ordinates, it may be called the *Axis*; and that Point where all the Diameters terminate, the *General Centre*.

Asymptotes and their Properties.

4. The Hyperbola of the First Gender has two Asymptotes; that of the Second, three; that of the Third, four; and it can have no more, and so of the rest. And as the Parts of any Right Line lying between the Conical Hyperbola, and its two Asymptotes are every where equal; so in the Hyperbola's of the Second Gender, if any Right Line be drawn, cutting both the Curve and its three Asymptotes, in three Points; the Sum of the two Parts of that Right Line being drawn the same Way from any two Asymptotes to two Points of the Curve, will be equal to the third Part drawn a contrary Way from the third Asymptote, to a third Point of the Curve.

Latus Transversa & Recta.

5. And as in Non-Parabolick Conick-Sections, the Square of the *Ordinate Applicata*, that is, the Rectangle under the Ordinates, drawn at contrary Sides of the Diameter, is to the Rectangle of the Parts of the Diameter, which are terminated at the Vertexes of the Ellipsis or Hyperbola, as a certain given Line, which is called the *Latus Rectum*, is to that Part of the Diameter that lies between the Vertexes, and is called the *Latus Transversum*: So in Non Parabolick Curves of the Second Gender, a Parallelopiped under the three *Ordinate Applicates*, is to a Parallelopiped under the Parts of the Diameter terminated at the *Ordinates*, and the three Vertexes of the Figure in a certain given *Ratio*: If you
take

take three Right Lines to the three Parts of a Diameter situated between the Vertexes of the Figure, one answering to another; then these three Right Lines may be called the *Latera Recta* of the Figure, and the Parts of the Diameter between the Vertexes, the *Latera Transversa*. And as in the Conick Parabola, having to one and the same Diameter but one only Vertex, the Rectangle under the Ordinates is equal to that under the Part of the Diameter cut off between the Ordinates and the Vertex, and a certain Line called the *Latus Rectum*: So in the Curves of the Second Gender, which have but two Vertexes to the same Diameter, the Parallelopiped under the three Ordinates, is equal to the Parallelopiped under the two Parts of the Diameter cut off between the Ordinates and those two Vertexes, and a given Right Line; which therefore may be called the *Latus Rectum*.

The Ratio of the Rectangles under the Segments of Parallels.

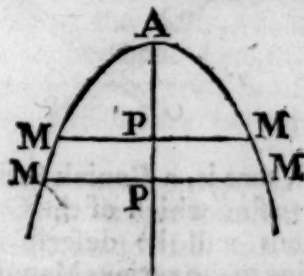
Lastly, As in the Conick-Sections, when two Parallels, terminated on each Side at the Curve, are cut by two other Parallels terminated on each Side by the Curve; the first being cut by the third, and the second by the fourth; as here the Rectangle under the Parts of the first, is to the Rectangle under the Parts of the third; as the Rectangle under the Parts of the second, is to that under the Parts of the fourth: So when four such Right Lines occur to a Curve of the Second Gender, each one in three Points, then shall the Parallelopiped under the Parts of the first Right Line be to that

under the Parts of the third as the Parallelopiped under the Parts of the second Line into that under the Parts of the fourth.

Hyperbolick and Parabolick Legs.

All the Legs of Curves of the second and higher Genders, as well as of the first, infinitely drawn out, will be of the Hyperbolick or Parabolick Gender; and I call that an *Hyperbolick Leg*, which infinitely approaches to some Asymptote; and that a *Parabolick one*, which hath no Asymptote. And these Legs are best known from the Tangents: For, if the Point of Contact be at an infinite Distance, the Tangent of an Hyperbolick Leg will coincide with the Asymptote; and the Tangent of a Parabolick Leg will recede *in infinitum*, will vanish, and no where be found. Wherefore, the Asymptote of any Leg is found, by seeking the Tangent to that Leg at a Point infinitely distant: And the Course, Place, or Way of an infinite Leg, is found by seeking the Position of any Right Line, which is parallel to the Tangent where the Point of Contact goes off *in infinitum*: For this Right Line is directed towards the same Way with the infinite Leg.

ORDINATES, or ORDINATE APPLICATES, are Parallel Lines



MM, terminating in a Curve, and bisected by a Diameter, as *AP*.

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The Half of which, as MP is properly the *Semi-Ordinate*, but it is usually call'd the *Ordinate*.

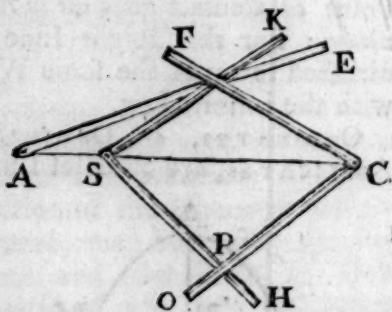
ORDNANCE, are all Sorts of great Guns used in War.

ORDONNANCE, signifies the same Thing in Architecture that it does in Painting; to wit, the Composition of a Building, and the Disposition of all its Parts; it being this that determines the Bigness of the several Members, whereof a Building is composed.

ORGANICAL DESCRIPTION of Curves, is the Description of them upon a Plane, by means of Instruments.

1. All Curves may be described upon a Plane, by the sole Help of Angles and Straight Lines, as Mr. *Mac-Laurin* has shewn in his Book *de Organica Geometria*.

2. If the given Angles FCO , and KSH move about two Points S and C given in any Plane, and the Concurrence of the Legs CF , SK , be moved along the Right Line AE given in Position in that Plane; then will the Concurrence P , if the other Legs CO , SH , describe a Curve of the first



Kind, that is, a Conick Section: And to find which of the Conick Sections will be describ'd according to the various Magnitude of the given Angles FCO , and KSH , and Position of the Line

O R

AE , describe a Segment of a Circle on the given Line CS ; containing an Angle equal to the Complement of the given Angles FCO , and KSH to four Right Angles: If the given Right Line AE meets that Circle twice, the Curve will be an Hyperbola: If it touches it, a Parabola: And if the Right Line AE falls quite beside the Circle, the Curve describ'd will be an Ellipsis.

3. While the Right Line AE remains, and the Sum of the given Angles FCO , and KSH , the Species of the Curve will be the same; and in no Case will a Circle be describ'd, but when the Right Line AE goes out to Infinity.

4. If the given Angles above are mutually the Supplements of each other to two Right ones, and the Line AE meets CS continu'd out; there will be an Hyperbola describ'd: If AE be parallel to CS , a Parabola will be describ'd.

ORGUES, in Fortification, are many Harque-Busses linked together, or divers Musket-Barrels laid in a Row, within one wooden Stock, so that they may be discharged either all at once, or separately. They are made use of to defend Breaches, and other Posts that are attack'd.

This Term is also appropriated to certain long and thick Pieces of Timber, armed with Iron Plates at the Ends, and separated one from another. They are hung with Cords over the Gates of a Town or Fortress, and in case of a Surprise, let fall perpendicular; by which Means the Passage is stopp'd, so that the Enemy cannot easily remove or hoist

O R

hoist up all the wooden Bars with a Leaver, or any other Machine set under them: On which Account, these Orgues are to be preferred before Herfes or Portcullices, because the Pieces whereof the latter consist are joined together; so that when any Part is hung or heaved up, the whole Machine is likewise removed. These Orgues therefore are much better than Portcullices.

ORIENT, is the Eastern Quarter of the Horizon, or is that Part of the Horizon where the Ecliptick, or the Sun therein, ascends into the Upper Hemisphere; and therefore, according to some Writers Way of Expression, the

Equinoctial Orient, is that Point of the Horizon which the Sun rises upon, when he enters in *Aries* or *Libra*.

Estival Orient, is that Point of the Horizon where the Sun rises, when he enters into *Cancer*.

ORIENTAL, in Astronomy: A Planet is said to be Oriental, when it rises in the Morning before the Sun.

ORILLON, in Fortification, is a small Rounding of Earth lined with a Wall, which is raised on the Shoulder of those Bastions that have Casemats to cover the Cannon in the retired Flank, and to prevent their being dismounted by the Enemy.

There are also other Sorts of Orillons, properly called *Shoulderings*, which are almost of a square Figure; they are called *Epaulements*.

ORION, a Southern Constellation, consisting of 39 Stars.

ORLE, a Term in Architec-

O R

ture; the same with *Plinth*, which see.

ORNAMENT, in Architecture, is any Piece of Carved Work, serving as a Decoration in Architecture: But the Word in *Vitruvius* and *Vignola*, is used to signify the *Entablement*.

ORTEIL, a Term in Fortification; the same with *Berme*, which see.

ORTHODROMIQUES, is the Art of Sailing in the Arch of some great Circle: For the Arch of every great Circle is *Orthodromia*, or the shortest Distance between any two Points on the Surface of the Globe.

ORTHOGRAPHY, in Mathematicks, is the true Delineation of the Fore-right Plane of any Object.

1. In Architecture, 'tis taken for the Model, Platform, and Delineation of the Front of a House that is to be built and contrived according to the Rules of Geometry; according to which Pattern, the whole Fabrick is erected and finished.

2. In Perspective, the Orthography of any Body or Building, is the Fore-right Side of any Plane; that is, the Side or Plane that lies parallel to a Straight Line, that may be imagined to pass thro' the outward Convex-Points of the Eyes, continued to a convenient Length. The Word *Schenography* is used by *Lamy*, and others in the same Sense.

3. In Fortification, it is the Profile or Representation of a Fortrefs, made after such a Manner, that the Length, Breadth, and Height of its several Parts may be discovered.

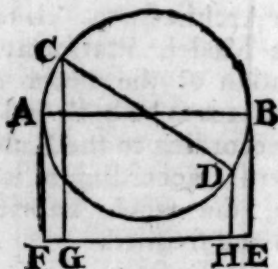
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ORTHOGRAPHICAL PROJECTION of the Sphere, is the drawing the Superficies of the Sphere in a Plane which cutteth it in the Middle, the Eye being placed at an infinite Distance vertically to one of the Hemispheres.

1. The Rays by which the Eye, at an infinite Distance, perceives any Object, are parallel.

2. A Right Line perpendicular to the Plane of the Projection, is projected into a Point, where that Right Line cuts the Plane of the Projection.

3. A Right Line, as AB , or CD , not perpendicular, but either Parallel or Oblique to the Plane of the Projection, is projected into a Right Line, as EF , or GH ; and is always compre-



hended between the extreme Perpendiculars AF , and BE .

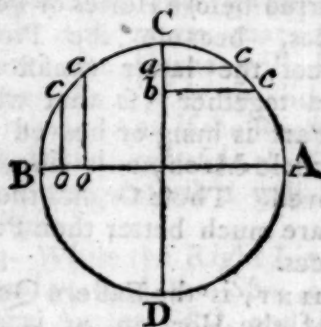
4. The Projection of the Right Line AB , is the greatest when AB is parallel to the Plane of the Projection.

5. From hence it is evident, that a Line parallel to the Plane of the Projection, is projected into a Right Line equal to itself; but if it be oblique to the Plane of the Projection, 'tis projected into one which is less.

6. A plain Surface, as $ABCD$, at Right Angles to the Plane of the Projection, is projected into that Right Line (as AB) in which it cuts the Plane of the Projec-

O S

tion. Hence it is evident, that the Circle $BCAD$ standing at Right Angles to the Plane of the Projection, which passes thro'



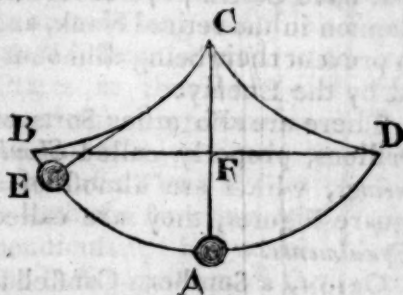
its Centre, is projected into that Diameter AB , in which it cuts the Plane of the Projection.

7. It is likewise evident, that any Arch, as cc is projected into oo , equal to Ca , Cb , which is the Right Sine of that Arch; and the Complemental Arch cA is projected into oA , the Versed Sine of the same Arch CC .

8. A Circle parallel to the Plane of the Projection, is projected into a Circle equal to itself; and a Circle oblique to the Plane of the Projection, is projected into an Ellipsis.

OSCILLATION, is the reciprocal Ascent and Descent of a Pendulum.

1. If a single Pendulum be suspended between two Semi-Cycloids BC , CD , that have the



Diameter CF of the generating Circle, equal to half the Length of

of the String, so that the String as it oscillates, folds about them; all the Oscillations, however unequal, will be Isochronal in a Non-resisting Medium.

2. The Time of an whole Oscillation, thro' any Arch of a Cycloid, is to the Time of the perpendicular Descent thro' the Diameter of the generating Circle, as the Periphery of the Circle to the Diameter.

3. If two Pendulums describe similar Arches of Circles, the Times of the Oscillations are in the Subduplicate Ratio of their Lengths.

4. The Number of Isochronal Oscillations made in the same Time by two Pendulums, are reciprocally as the Times wherein each of the Oscillations are made. The Times of the Oscillations in different Cycloids, are in the Subduplicate Ratio of the Length of the Pendulums.

5. The Length of a Pendulum that will perform its Oscillations in a second, is three Foot eight Inches and a half of *Paris* Measure.

6. The shorter the Oscillations in the Arch of a Circle are, the truer will the Pendulum measure Time, or the more Isochronal will the Oscillations be.

OSTENSIVE DEMONSTRATIONS, are such as plainly and directly demonstrate the Truth of any Proposition; in which they are distinguished from Apogogical ones, or *Deductiones ad absurdum*, *sive ad impossibile*, which prove the Truth proposed, by demonstrating the Absurdity or Impossibility of asserting the contrary.

OSTENSIVE DEMONSTRATIONS are of two Sorts; some of which barely (but directly) prove the

Thing to be, which they call *δτι*; and others demonstrate the Thing from its Cause, Nature, or Essential Properties, and these are called in Schools *διότι*.

OTACOUSTICKS, are Instruments which help or improve the Sense of Hearing.

OVAL, in Architecture, the same with Echinus. Some write it Ova, because of its Figure, being like an Egg; it is placed in the Mouldings of the Cornices for Ornament; and in a Pillar it is placed next to the Abacus.

OVAL FIGURE, in Geometry, is a Figure, as *A*, bounded by a regular Curve-Line returning into itself; but of its two Diameters cutting each other at Right



Angles in the Centre, one is longer than the other, in which it differs from the Circle. Every Ellipsis is an Oval Figure; but every Oval Figure is not an Ellipsis.

OUTWARD Flanking-Angle, or the Angle of the *Tenaille*, is that comprehended by the two Flanking-Lines of Defence.

OUT-WORKS, in Fortification, are all sorts of Works, which are raised without the Inclosure of a Place, and serve for its better Defence, and to cover it from the Enemy, in the Plain without; as Ravelins, Half-Moons, Horn-Works, Crown-Works, Counter-Guards, *Tenailles*, &c.

1. It is a general Rule in all Out-Works, that if there be several of them, one before another, to cover one and the self-

P A

same Tenaille of a Place, the nearer Ones must gradually, and one after another, command those which are farthest advanced out into the Campagne; that is, must have higher Ramparts, that so they may overlook and fire upon the Besiegers, when they are Masters of the more Outward-Works.

2. The Gorges also of all Out-Works must always be plain, and without Parapets; lest, when taken, they should serve to secure the Besiegers against the Fire of the retiring Besieged; wherefore the Gorges of Out-Works are only pallisado'd to prevent a Surprise.

OVOLO, in Architecture; see *Quarter-Round*.

OXYGONE, the same with an Acute-angled Triangle, and in general.

OXYGONIAL, is Acute-Angular.

P.

PALLET, is a Term belonging to the *Ballance* of a Watch, or Movement.

PALLIFICATION, in Architecture, is the Piling the Ground-Work, or strengthening it with Piles or Timber driven into the Ground, when they build upon a moist or marshy Soil.

PALLISADES TURNING, are an Invention of Mr. Coehornes: For, in order to preserve the Pallisades of the Parapet from the Besiegers Shot, he orders them so, that as many of them stand in the Length of a Rod, or in about ten Foot, turn up and down like

P A

a Trap; so that they are not in sight of the Enemy, but only just when they bring on their Attack, and yet are always ready to do the proper Service of Pallisades.

PALLISADOES, or PALLISADES, in Fortification, are strong wooden sharp-pointed Stakes, six or seven Inches square, eight Foot long, of which three Foot is in the Ground; set up half a Foot sometimes one above another, with a cross Piece of Timber that binds them together. Some of these are also sometimes arm'd with two or three Iron Spikes.

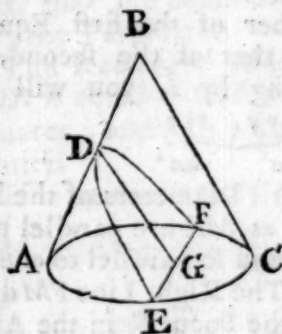
1. These Pallisadoes are usually fixed in the void Spaces without the Glacis near the Bastions and Curtains; and in Avenues of all such Posts as are liable to be surprized by the Enemy, or carried by Assault. Sometimes they are driven downright in the Ground, and sometimes stand at an Acute-Angle towards the Enemy, that if they should throw Cords about them to pull them up, they may slip off again.

2. Pallisadoes are always planted on the Berme of Bastions, and at the Gorges of Half-Moons, and other Out-Works: They also pallisade usually the Bottom of the Ditch; and to be sure, the Parapet of the Cover'd-Way: And tho' sometimes they have placed these Pallisadoes three Foot, from the said Parapet outwards towards the Campagne; yet of late they have been planted in the very Middle of the Cover'd-Way: All Pallisadoes should stand so close, as to admit between them only the Muzzel of a Musket, or Pike.

PARA-

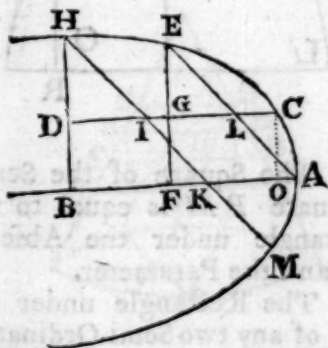
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PARABOLA, is a Curve, as EDE , made by cutting a Cone by a Plane DG , parallel to one of its Sides, as BC .



1. All Diameters (DC) of a Parabola, are parallel to the Axis BA , and so are parallel to one another.

From A draw the Line AE , which may be bisected by the Diameter DC in the Point L ; and thro' any Point K in the Axis draw HKM . Also from the Points H, E, C , draw the Semi-Ordinates HB, EF, CO , to the Axis, which will be all perpendicular to the same; then call



the given Line CO , or GF , or DB , a ; and BH , y ; and the Parameter to the Axis p . Now

$OA = \frac{aa}{p}$, $EA = \frac{4aa}{p}$, and $GL = \frac{aaa}{p}$,
(because the Triangles EFA ,

P A

EGL , being similar, and the Side EA bisected in L , the Side EG shall be bisected in G , and GL shall be $= \frac{1}{2} FA$) and

$LC = \frac{aa}{p}$ ($= OA$) and $EL^2 = aa + \frac{4a^4}{pp}$. And because the Tri-

angles EFA, HBK , are similar, therefore $EF (2a) : FA$

$(\frac{4aa}{p}) :: HB (y) : BK = \frac{2ay}{p}$.

But $BA - BK + OA = LC = \frac{yy - 2ay + aa}{p}$, since IL is $= KA$

and $OA = LC$. Therefore $LC (\frac{aa}{p}) : IC (\frac{yy - 2ay + aa}{p}) ::$

$EG^2 : (aa) HD^2 (yy - 2ay + aa) ::$

$EL^2 : HI^2$, because the Triangles DHI, GEL , are similar, and consequently $EC : IC :: EL^2 : LA^2$.

And drawing a Perpendicular from the Point M to DC , and reasoning after the same Manner, you will have $CL : CD ::$

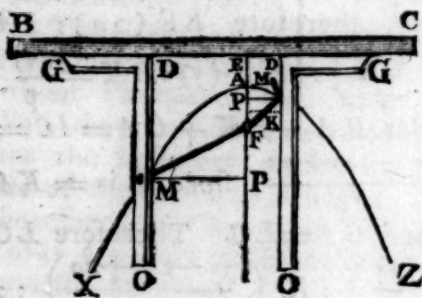
$LA^2 (= LE^2) : IM^2$. Whence IM is $= IH$; and because the Point K

is taken at pleasure in the Axis, therefore all Right Lines drawn parallel to EA , shall be bisected by the Line DC , and so the same shall be a Diameter according to the Definition, and the Lines EA and HKM shall be Ordinates to it.

2. If the Rule BC be placed upon a Plane, together with the Square GDO , in such Manner, that DG , one of its Sides, lies along the Edge of that Rule; and if you take the Thread FMO equal in Length to DO , the other Side of the Square, and fix one End thereof to O the Extremity of the Side DO , and the other in any Point F , taken in the Plane on the

P A

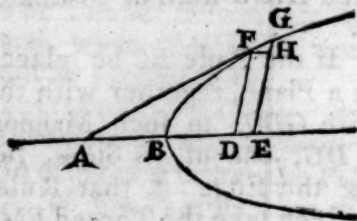
the same Side of the Rule as the Square: This being done, if you slide *DG*, the Side of the Square along the Rule *BC*, and at the same Time keep the Thread continually tight by means of the Pin *M*, with its Part *MO* close to the Side of the



Square *DO*: The Curve *AMX*, which the Pin describes by this Motion, is one Part of a Parabola.

And if the Square be turn'd about, and moves on the other Side of the fixed Point *E*, the other Part *AMZ* of the same Parabola may be described after the like Manner; so that the Line *XAZ* will be one and the same Curve.

3. To draw a Tangent to the Parabola; let *AE* be the Axis, *DF*, *EG*, two Ordinates infinitely near



to each other, and *FH* parallel to *AE*; let *p* = Parameter, and *x* = *BD*,

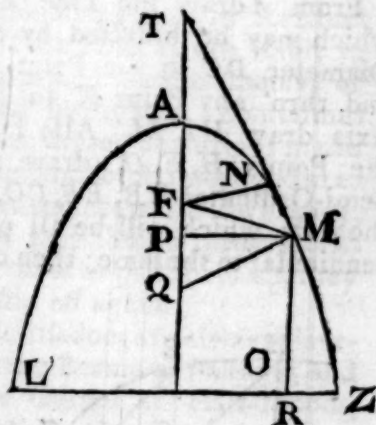
P A

and *y* = *DF*, and *s* = *DE*. Then $px = yy$, and $px + ps = yy + \frac{2yy s}{a}$

$+ \frac{ssyy}{aa}$. Now subtracting each Member of the first Equation from that of the second, and dividing by *s*, you will have

$$p = \frac{2yy}{a} + \frac{ssy}{aa}$$

4. All Diameters of the Parabola, as *MR* are parallel to the Axis, and so parallel to one another. The Right Line *FM* drawn from the Focus *F*, in the Axis to the Extremity of the Semi-Ordinate *PM*, is equal to the Abscisse *AP* and *AF*; the Distance of the Focus from the Vertex.



5. The Square of the Semi-Ordinate *PM* is equal to the Rectangle under the Abscisse *AP*, and the Parameter.

6. The Rectangle under the Sum of any two Semi-Ordinates, and their Difference, is equal to a Rectangle under the Parameter, and the Difference of the Abscisses.

In the Parabola, the Sub-Tangent *PT* is twice the Abscisse *AP*, and the Sub-Normal *PQ* = $\frac{1}{2}$ the

P A

the Parameter, and so is a constant Quantity.

7. The Focus of the Parabola is at such a Distance from the Vertex, that the Semi-Ordinate $FN = \frac{1}{2}$ the Parameter.

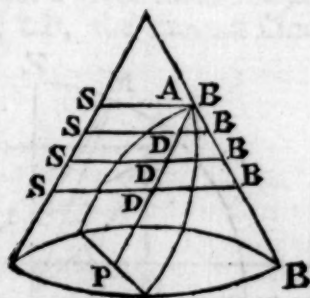
8. The Rectangle under LO and OZ is equal to OM into the Parameter; and so is a constant Quantity.

9. If a be the Parameter, and $y = PM$, then $y + \frac{2y^3}{3a^2} - \frac{2y^5}{5a^4} + \frac{4y^7}{7a^6} - \frac{10y^9}{9a^8}$ &c. will be the Length of the Curve AM of the Parabola.

PARABOLA's of the higher Kinds, are Algebraick Curves, that are expressed by $m^{m-1}x + y^m$.

PARABOLICK CONOID. See Conoid Parabolical.

PARABOLICK CUNEUS, is a Solid mention'd by Dr. Wallis, and is formed thus: Multiply all the DB's into the DS's, or which is all one, upon the Base APB erect a Prism, whose Altitude



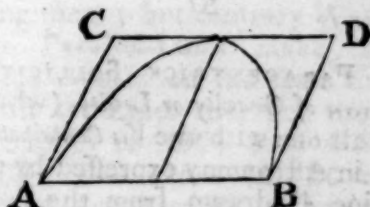
shall be AS, and this shall be the Parabolical Cuneus, which is equal in Solidity to the Parabolical Piramidoid.

PARABOLICK PIRAMIDOID, is a solid Figure, thus named by Dr. Wallis, from its Genesis, or Formation, which is thus,

P A

Let all the Squares of the Ordinates of a Parabola be imagin'd to be so placed, that the Axis shall so pass thro' all their Centres at Right Angles; and the Aggregate of these Planes will form the Parabolick Piramidoid, whose Solidity is gain'd by multiplying the Base by half the Altitude.

PARABOLICK SPACE, is the Area contain'd between the Curve of the Parabola, and a whole Ordinate AB.



This is $\frac{2}{3}$ of the circumscribing Parallelogram ACDB, in the common Parabola.

PARABOLICK SPINDLE, is a Solid made by the Rotation of a Semi-Parabola about one of its Ordinates, and is equal to $\frac{8}{3}$ of its circumscribing Cylinder.

PARABOLICK SPIRAL. See Helicoid Parabola.

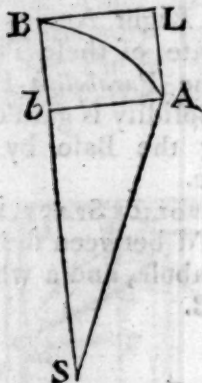
PARABOLOIDES, or PARABOLIFORM CURVES, are Parabola's of the higher Kind.

The Equation for all Curves of this Kind being $a^{m-n}x = y^n$, the Proportion of the Area of any one to the Complement of it to the circumscribing Parallelogram will be as m to n .

PARACENTRICK MOTION of Impetus, is a Term in the New Astronomy, for so much as the revolving Planet approaches nearer to, or recedes farther from the Sun or Centre of Attraction. Thus if a Planet in A move

P A

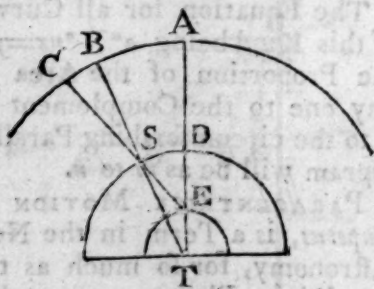
**A moves to B, then is $SB-SA=bB$,
the Paracentrick Motion of that
Planet.**



PARACENTRICK SOLLICITATION of Gravity or Levity, (which is all one with the *Vis Centripeta*,) is in Astronomy expressed by the Line *AL* drawn from the Point *A*, parallel to the Ray *SB*, (infinitely near *SA*,) until it intersects the Tangent *BL*.

PARALLACTICAL ANGLE, is the Difference of the Angles *CEA*, and *BT A*, under which the true and apparent Distances from the *Zenith* are seen.

PARALLAX, or PARALLAX of Altitude, is CB (or the Angle TSE , which may be taken for it) the Difference between the true Place B of the Planet S , and the



apparent Place C of the same;
this is equal to the Difference

P A

between AB , the true Distance from the Zenith A , and the apparent Distance AC .

PARALLAX of *Ascension* or *De-*
scension, is an Arch of the Equi-
noctial, whereby the *Parallax* of
Altitude augments the Ascension,
and diminishes the Descension of
a Planet.

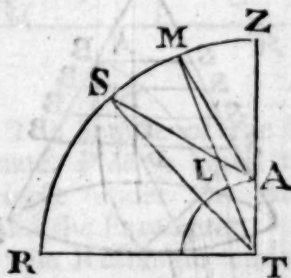
PARALLAX of Declination, is an Arch of a Circle of Declination, whereby the *Parallax of Altitude* augments or diminishes the Declination of a Planer.

PARALLAX of Latitude, is an Arch of a Circle of Latitude, whereby the *Parallax of Altitude* augments or diminishes the Latitude.

PARALLAX of *Longitude*, is an Arch of the Ecliptick, whereby the *Parallax of Altitude* augments or diminishes the *Longitude*.

1. The Parallax's in the *Zenith* is nothing, but in the *Horizon* the greatest.

2. The Sines of the *Parallactical Angles* AMT , AST , at the same or equal Distances SZ from the *Zenith* are in the reciprocal Ra-



tion of the Distances TL , and TS from the Centre of the Earth.

3. The Sines of the *Parallaxical Angles* of the Stars *M* and *S*, equally distant from the Centre of the Earth *T*, are as the Sines of the apparent Distances *ZM* and

P A

and ZS from the *Zenith*. The fixed Stars have no sensible Parallax.

4. The Horizontal Parallax is the same, whether a Star be in the true Horizon, or the apparent Horizon.

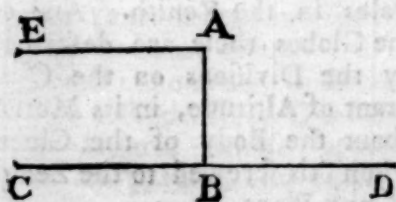
5. The Moon's greatest Horizontal Parallax, is $1^{\circ} 1' 25''$. and the least $54' 5''$.

6. The Horizontal Parallax of Mars, when greatest is about $25''$, and that of the Sun is about $10''$.

PARALLEL-LINES, in Geometry, are those which run always equi-distant from each other; so that if they were infinitely produced, they would neither go further from, nor come nearer to each other; and their Distance is always measured by a Perpendicular, which, wherever it be taken, is of the same Length, or is always equal to itself.

1. Sir *Isaac Newton*, in the 22d Lemma of the first Book of his *Principia*, defines Parallels to be such Lines that tend to a Point infinitely distant.

2. Or Parallel-Lines may be defined thus: If A be a Point without a given indefinite Right Line CD, the shortest Line, as

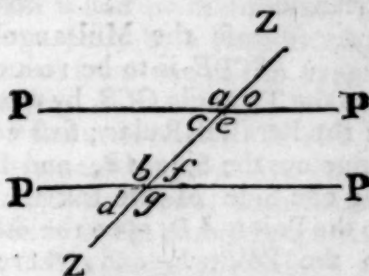


AB that can be drawn from A to it, is perpendicular, and the longest, as EA is parallel to CD.

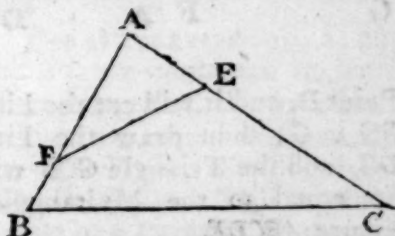
3. A Right Line ZZ falling on two Parallel-Lines PP and PP, makes the Alternate Angles

P A

$c=f$, and $e=b$; also $c=d$, and $a=g$, and the two Internal Angles $c+b$, or $e+f$ two Right ones.



4. Anti-Parallels are those Lines that make the same Angles with two Lines cutting them; but contrary Ways: As Parallel-Lines make the same Angles on the same Side with the Lines that cut them, viz. AFE to ABC: So if $AFE = ACB$: The Lines FE, BC are called *Anti-Parallels*. When the



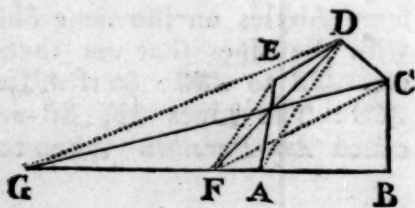
Sides of a Triangle as AB, AC, be cut by a Line FE, Anti-Parallel to the Base BC, the said Sides are cut reciprocally by the said Line FE.

PARALLEL-PLANES, are those Planes which have all the Perpendiculars drawn betwixt them equal to each other; that is, when they are every where equally distant.

PARALLEL-RULER, is an Instrument of Wood, Brass, Silver, &c. consisting of two Parallel-Rules that open and shut parallel to one another; and is of great Use in all Parts of Mathematicks

maticks, where many Parallel-Lines are to be drawn; and is particularly useful in reducing of any Multangular Figure into a Triangle.

As suppose the Multangular Figure $ABCDE$ is to be reduced into the Triangle GCB , by means of the Parallel-Ruler; first continue out the Side AB , and laying one Side of the Instrument to the Points A, D , open the other to the Point E , and where it cuts the Line AG , as in F make a Mark; this being done, lay one Side of the Ruler to the Points E, C , and open the other to the



Point *D*, and it will cut the Line *BG* in *G*; then draw the Line *DG*, and the Triangle *GCB* will be equal to the Multangular Figure *ABCDE*.

PARALLEL SAILING, in Navigation, is sailing under a Parallel of Latitude; of this there are but three Cases.

1. Given, the Departure and Distance ; required, Latitude.

The Canon is, as the Difference of Longitude is to the Radius: So is the Distance to the Co-Sine of the Latitude.

2. Given, the Difference of Longitude between two Places under the same Parallel; required their Distance.

The Canon is, as the Radius
is to the Difference of Longitude:
So is the Co-Sine of the Latitude
to the Distance.

3. Having the Distance between two Places in the same Latitude, required their Difference of Longitude.

The Canon is, as the Co-Sine
of the Latitude is to the Distance;
So is the Radius to the Differ-
ence of Longitude.

PARALLEL SPHERE, is where the Poles are in the *Zenith* and *Nadir*, and the *Equator* in the Horizon, which is the Case of such (if any such there be) who live directly under the North and South Poles.

The Consequences of this Position are, that the Parallels of the Sun's Declination will also be Parallels of his Altitude.

The Inhabitants can see only such Stars as are on their Side of the Equinoctial; and they must have six Months Day, and six Months continual Night every Year; and the Sun can never be higher with them, than 23 Degrees 30 Minutes, which is not so high, as he is with us in February.

PARALLELS of *Altitude*, or *Almacanters*, are Circles parallel to the Horizon, imagined to pass thro' every Degree and Minute of the Meridian, between the Horizon and Zenith, having their Poles in the Zenith. And on the Globes these are described by the Divisions on the Quadrant of Altitude, in its Motion about the Body of the Globe, when 'tis screwed to the Zenith of any Place.

PARALLELS of Latitude on the Terrestrial Globes, are the same with Parallels of Declination on the Celestial : But the Parallels of Latitude on the Celestial Globes, are small Circles parallel to the Ecliptick, imagined to pass thro' every

every Degree and Minute of the Colures, and are represented there by the Divisions of the Quadrant of Altitude, in its Motion round the Globe, when it is screwed over the Poles of the Ecliptick.

PARALLELS of *Declination*, are Circles parallel to the Equinoctial, imagined to pass thro' every Degree and Minute of the Meridians between the Equinoctial, and each Pole of the World.

PARALLEL RAYS, in Opticks, are those that keep an equal Distance from the visible Object to the Eye, which is supposed to be infinitely remote from the Object.

PARALLEL CIRCLES on the Globes; the same with the *Lesser Circles*.

PARALLELS also on the *Terrestrial Globe*, are Circles drawn thro' the Middle of every Climate, dividing them into two Halves, which are called *Parallels*.

PARALLELISM of the *Earth's Axis*, is the Earth's keeping its Axis in its annual Revolution round the Sun, in a Position always parallel to itself, which it doth nearly, but not exactly; for tho' the Difference be insensible in one Year, it becomes sensible enough in many Years.

PARALLELOGRAM, in Geometry, is a Right-lined Quadrilateral Figure, whose opposite Sides are parallel and equal.

1. The opposite Angles of all Parallelograms are equal to one another.

2. All Parallelograms that are between the same Parallel-Lines, and on one and the same Base, are equal.

3. All similar Parallelograms

are to one another in the Duplicate Ratio of their Homologous Sides.

4. The Area of any Parallelogram is had by multiplying one of its Sides by a Perpendicular let fall from one of the opposite Angles.

PARALLELOGRAM, is also an Instrument made of five Rulers of Brass or Wood, with Sockets to slide or set to any Proportion, used to enlarge or diminish any Map or Draught, either in Fortification, Building, or Surveying, &c.

PARALLELOGRAM PROTRACTOR, is a Semi-Circle of Brass, with four Rulers, in Form of a Parallelogram, made to move to any Angle: One of which Rulers is an Index, which shews on the Semi-Circle the Quantity of any inward or outward Angle.

PARALLELEPIPEDON, is a solid Figure contained under six Parallelograms, the Opposites of which are equal and parallel; or 'tis a Prism, whose Base is a Parallelogram. This is always triple to a Pyramid of the same Base and Height.

PARALLELOPLEURON, a Word used by some Geometricians for an imperfect Parallelogram, or kind of Trapezium, having unequal Angles and Sides, yet not also in regard that at least some of them answer to one another, observing a certain Regularity and Proportion of Parallels; so that they do not extend so largely as Trapeziums, which are any irregular four-sided Figures; nevertheless, like them, they are capable of being variously diversified.

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PARALOGISM, is a pretended Demonstration or Method of arguing, but which is in reality fallacious and false.

PARAMETER, by some, as *Mydorgius* and others, called the *Latus Rectum* of a Parabola, is a third Proportional to the Abscissa and any Ordinate.

But in the Ellipsis and Hyperbola, it is a third Proportional to two Conjugate Diameters.

PARAPET, in Fortification, is an Elevation of Earth and Stone upon the Rampart, behind which the Soldiers stand secure from the Enemy's great and small Shot, and where the Cannon is planted for the Defence of the Town or Fortrefs.

Every Parapet having its Embrasures and Merlons, is about six Foot high on the Side of the Place, and from four to five in that towards the Country. So that this Difference of Height forms a kind of Glacis above, from whence the Musqueteers mounting the Banquet of the Parapet, may easily fire into the Moats, or at least upon the Counterscarp. It ought also to be from eighteen to twenty Foot thick, if made of Earth; and from six to eight if of Stone. The Earth is much better than Stone, because Stone will fly to pieces, when battered, and do mischief.

This Word Parapet is also given to any Line that covers Men from the Enemy's Fire: So there are Parapets of Barrels, of Gabions, of Bags filled with Earth, &c.

PARASTÆ, in Architecture, are the same with Pilasters; the *Italians* call them *Membretti*.

PARHELII and **PARHELIA**, or

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such Phænomena, as we call Mock-Suns, are the Representations of the Face or Figure of the True-Sun by way of Reflexion in the Clouds.

PARTICLES, are the very small Parts of which any natural Body is supposed to be compounded; and these are often called the Constituent or Component Particles of any natural Body.

PATE, in Fortification, is a kind of Platform like what they call an *Horseshoe*, not always regular, but generally oval, encompassed only with a Parapet, and having nothing to flank it; is usually erected in marshy Grounds to cover a Gate of a Town.

PATH of the Vertex, is a Term frequently used by Mr. *Flamsteed*, in his *Doctrine of the Sphere*, and signifies a Circle described by any Point of the Earth's Surface, as the Earth turns round its Axis. This Point is considered as Vertical to the Earth's Centre, and is the same with what is called the *Vertex*, or the *Zenith* in the *Ptolemaick Projection*.

The Semi-Diameter of this Path of the Vertex is always equal to the Complement of the Latitude of the Point or Place that describes it; that is, to that Place's Distance from the Pole of the World.

PAUSE, or REST, in Musick, is a Silence, or artificial Intermission of the Voice or Sound, proportioned to a certain Measure of Time, by the Motion of the Hand or Foot.

These Pauses or Rests are always equal to the Length or Quantity of the Notes whereto they are annexed, and therefore are called by the same Names,

as

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as a *Long-Ref*, *Breve-Ref*, *Semi-Breve-Ref*, &c.

PEDESTAL, in Architecture, is a square Body, with a Base and Cornice, serving as a Foot for the Columns to stand upon ; it is in different Orders.

1. The *Tuscan* Pedestal, being the most simple of all, hath only a Plinth for its Base, and an Astragal crowned for its Cornice.

2. The *Dorick* Pedestal (according to *Palladio*) borrowing the *Attick* Base, ought to have for its Height $2\frac{1}{3}$ Diameters of the Column taken before : But no Pedestals to this Order are seen among the antient Buildings.

3. The *Ionick* Pedestal is two Diameters, and about two Thirds high.

4. The *Corinthian* Pedestal hath the fourth Part of the Column for its Height, being divided into eight Parts ; whereof one must be allowed for the Cymatium, two others for the Base, and the rest for the Dye or Square.

5. The *Composite* Pedestal ought to have the third Part of the Pillar for its Height.

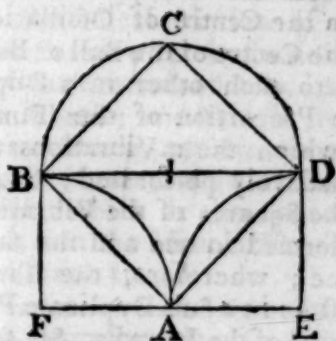
PEDIMENT, in Architecture, is an Ornament that crowns the Ordonnance, finishes the Fronts of Buildings, and serves as a Decoration over Gates, Windows, Niches, &c. it is ordinarily of a Triangular Form, but sometimes makes an Arch of a Circle.

PEERS, in Architecture, are kind of Pilasters or Buttresses for Support, Strength, and sometimes Ornament.

PEGASUS, a Constellation in the Northern Hemisphere ; containing 23 Stars.

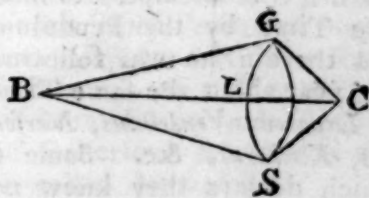
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PELICOIDES, is the Name given by some to the Figure *BCDA*, contained under the two inverted Quadrantal Arches *AB* and *AD*, and the Semi-Circle



BCD, whose Area = to the Square *AC*, and that to the Rectangle *EB*.

PENCIL of Rays, in Opticks, is a double Cone of Rays joined together at the Base ; one of which hath its Vertex in some other Point of the Object, and the Glass *GLS* for its Base ; and the other hath its Base on the same Glass, but its Vertex in the Point of Convergence, as at *C*.



Thus *BGSC* is a *Pencil of Rays*, and the Line *BLC*, is called the *Axis of that Pencil*.

PENDULUM, is a Weight hanging at the End of a String, Chain, or Wire, by whose Vibrations or Swings to and fro, the Parts or Differences of Time are measured.

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1. The Velocities of Pendulums in their lowest Points, are as the Chords of the Arches they fall from or describe.

2. The Lengths of Pendulums (which are always accounted from the Centre of Oscillation, to the Centre of the Ball or Bob) are to each other in a Duplicate Proportion of the Times, in which their Vibrations are respectively performed; or are as the Squares of the Vibrations performed in one and the same Time; wherefore, the Times must be in a Sub-Duplicate Proportion of the Lengths. Sir *Isaac Newton* demonstrates, *Cer. 2. Prop. 54. Princip.* that if the Force of the Movement of a Clock required to keep a Pendulum so adjusted, that the whole Force or Tendency downwards shall be as the Line which arises by dividing the Rectangle under the Semi-Arch of the Vibration and the Radius, is to the Sine of that Semi-Arch, then all the Oscillations shall still be made in the same Space of Time.

3. 'Tis said, that *Ricciolus* was the first that attempted to measure Time by the Pendulum, and therein he was followed, tho' near about the same Time, by *Langrenus Vendelinus*, *Mersennus*, *Kircherus*, &c. Some of which declare they knew nothing of *Ricciolus's* Attempt; but the first that applied it to a Movement, Clock, or Watch, was Mr. *Christian Hugen*s, and who brought it also to a good Degree of Perfection.

PENDULUMS-ROYAL, are those Clocks, whose Pendulum swings Seconds, and goes eight Days, a Month, &c. shewing the Hour, Minutes, and Seconds.

PENINSULA, in Geography, is a Portion of Land, which being almost surrounded with Water, and is joined to the Continent only by an Isthmus, or narrow Neck of Land; as *Africa*, the greatest Peninsula in the World, is joined to *Asia*, and that of the *Marea* to *Greece*, &c.

PENTAGON, in Geometry, is a Figure having five Sides, and five Angles: If all the Sides be equal, and also the Angles, it is called a *Regular Pentagon*.

The Side of a *Regular Pentagon*, or one which can be inscribed in a Circle, is in Power equal to the Side of an *Hexagon* and *Decagon*, inscribed in the same Circle.

PENTANGLE, a Figure having five Angles.

PENUMBRA, in Astronomy, is a faint Kind of a Shadow, or the utmost Edge of the perfect Shadow, which happens at the Eclipse of the Moon; so that it is very difficult to determine where the Shadow begins, and where the Light ends.

PERAMBULATOR, the same as the *Surveying-Wheel*, is an Instrument made of Wood or Iron, commonly half a Pole in Circumference, with a Movement, and a Face divided like a Clock, with a long Rod of Iron or Steel, that goes from the Centre of the Wheel to the Work: There are also two Hands, which (as you drive the Wheel before you) count the Revolutions; and from the Composition of the Movement, and by the Division on the Face, shew how many Yards, Poles, Furlongs, and Miles, you go. The Use of this Instrument is to measure Roads, Rivers, and all Level Lands, with great Expedition.

PERCH,

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PERCH, a Measure, by our Statute-Law, of sixteen Foot and a half in Length.

PERFECT CONCORDS, in Musick; see *Concords*.

PERFECT FIFTH, the same with *Diapente*; which see.

PERFECT NUMBERS, are such whose aliquot, or even Parts joined together, will exactly return the whole Number; as 6 and 28, &c. For of six, the half is three, the third Part two, and the sixth Part one, which added together, make six; and it hath no more aliquot Parts in whole Numbers; so twenty eight, which has these Parts, viz. 14, 7, 4, 2, and 1, exactly return 28; which therefore is a Perfect Number, whereof there are but Ten between One, and one Million of Millions.

If $2nx$ be put for a Perfect Number; then will it be $=1+2+4+8$, &c.

As if $n+1$, then $x=1+2=3$, and the Perfect Number $2nx=6$, if $n=2$.

Then $x=1+2+4=7$, and so $2nx=28$. If $n=3$; then $x=1+2+4=7$, and consequently $2nx=120$.

PERIGÆON, or **PERIGÆUM**, is a Point in the Heavens, wherein a Planet is said to be in its nearest Distance possible from the Earth.

PERIHELION, is that Point of a Planet's Orbit, wherein it is nearest to the Sun.

PERIMETER, is the Bounds of any Figure.

PERIOD, in Chronology, signifies a Revolution of a certain Number of Years; as the *Metonic* Period, the *Julian* Period, and the *Calippick* Period; which see in their proper Places.

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PERIODICAL, is the Term for whatsoever performs its Motion, Course, or Revolution regularly, so as to return again, and to dispatch it always in the same Period, or Space of Time. Thus the Periodical Motion of the Moon, is that whereby she finishes her Course round about the Earth in a Month; and this is in 27 Days, 7 Hours, 45 Minutes, and is called the *Moon's Periodical Month*; which is the Space of Time that the Moon finishes her Revolution in.

PERIPHERY, in Geometry, is the Circumference of a Circle, or of any other Regular Curvilinear Figure.

PERISCII, are the Inhabitants of the two frozen Zones, or those that live within the Compass of the *Arctic* and *Antarctic* Circles; for as the Sun never goes down to them after he is once up, but always round about, so do their Shadows. Whence the Name.

PERISTYLE, in Architecture, is a Place or Building encompassed with Pillars standing round about within the Court: But this Word *Peristyle* is sometimes taken for a Row or Rank of Columns, as well without as within any Edifice, as in Cloysters and Galleries. Sometimes this was called *Antiprostyle*.

PERITERE, in Architecture, is a Place encompassed round with Columns, and with a kind of Wings about it. Here the Pillars stand without, whereas in the Peristyle they stand within.

PERITROCHIUM. See *Axis in Peritrochium*.

PERIÆCI, are those Inhabitants of the Earth, who lived

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under

under the same Parallels, but under opposite Semi-Circles of the Meridian, whence they have the same Seasons of the Year, viz. Spring, Summer, Autumn, and Winter, at the very same Time; as also the same Length of Days and Nights; for 'tis in the same Climate, and at an equal Distance from the Equator: But the Changes of Noon and Midnight are alternate one to the other.

PERMUTATION of Quantities. See Variation and Combination.

PERPENDICULAR, in Geometry, is when a Right Line standeth so upon another, that the Angles on either Side are equal; then this Right Line, which so standeth, is perpendicular to that upon which it standeth. A Right Line is said to be

PERPENDICULAR to a Plane, when 'tis perpendicular to more than two Lines drawn in that Plane. One Plane is perpendicular to another, when a Line in one Plane is perpendicular to the other Plane.

PERPETUAL MOTION. By this Term ought to be meant an uninterrupted Communication of the same Degree of Motion from one Part of Matter to another, in a Circle (or such-like Curve returning into itself) so that the same Quantity of Matter shall return perpetually undiminished upon the first Mover: And perhaps, if Men had rightly understood that this is the true Meaning of a perpetual Motion, Abundance of Expence both of Money and Reputation might have been saved, by the vain Pretenders to this Piece of impossible Mechanism.

1. When a Wheel, or other

Machine, once set in Motion, will, without additional Actions on it, continue to move with the same, or a greater Velocity, with which it first moved, as long as the Matter of which it consists, remains the same; such a Motion, by Mechanicks, is called *Perpetual*.

2. But since Bodies have not in themselves Power to move themselves; and therefore have not Power to increase or diminish a Motion given them: If they are not acted on by other Bodies, they will continue so to move, and with the same Velocity: But all revolving Bodies suffer Friction with those, by which they are suspended; and the Velocities of those Bodies are therefore continually lessen'd by the Action of Friction. Therefore, a Wheel, or other Machine, set in Motion without additional Actions on it, will not continue to move with the same Velocity, tho' the Matter of which it consists remains the same: But, on the contrary, this Velocity will be continually diminished.

3. Moreover, since by numberless Experiments, the most polite or burnish'd Bodies sliding over one another, lose all the Motion which hath been given them, and in a short Time: Therefore every Wheel, or any other such Machine will, in a short Time, lose its Motion.

4. Hence it appears, that the perpetual Motion is not to be expected by a single Wheel.

5. And if any Contrivance cause one Part of a Wheel to preponderate another; whatsoever is gained by the Descent of that

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that preponderating Part, will be lost in its Ascent; and then the Wheel thus loaded, as soon as the Friction hath destroyed the Motion given it, will for a while vibrate like other pendulous Bodies, and then at last stand still. Consequently no perpetual Motion by Wheel-Work.

PERSEUS, a Constellation in the Northern Hemisphere, consisting of 38 Stars.

PERSICK ORDER of Architecture, is where the Bodies of Men serve instead of Columns to support the Entablature; or rather the Columns are in that Form.

The Rise of it was this; *Pausanias* having defeated the *Persians*, the *Lacedemonians*, as a Mark of their Victory, erected Trophies of the Arms of their Enemies, and then represented the *Persians* under the Figures of Slaves, supporting their Porches, Arches, or Houses.

PERSPECTIVE, is an Art that teaches us the Manner of delineating by mathematical Rules; that is, it shews us how to draw geometrically upon a Plane, the Representations of Objects according to their Dimensions, and different Situations; in such manner, that the said Representations produce the same Effects upon our Eyes, as the Objects whereof they are the Pictures.

PERSPECTIVE ÆRIAL, is a proportional Diminution of the Lineaments and Colours of a Picture, when the Objects are supposed to be very remote.

PERSPECTIVE LINEAL, is the Diminution of those Lines in the Plane of a Picture, which are the Representation of other Lines very remote.

PERSPECTIVE MILITARY, is

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when the Eye is supposed to be infinitely remote from the Table or Plane.

PERTICA, a Sort of a Comet; the same with *Venu*.

PETARD, in Fortification, is an Engine of Metal in the Form of an high-crown'd Hat, with narrow Brims, which being fill'd with very fine Powder, well primed, and then fixed with a Madrier or Plank, bound fast down, with Ropes running thro' Handles, which are round the Rim of the Mouth of it, to break down Gates, Port-Cullices, Draw-Bridges, Barriers, &c. This Engine is from 7 to 8 Inches deep, and 5 broad at the Mouth; the Diameter at the Bottom or Breech is an Inch and a half, and the Weight of the whole Mass of Metal is from 55 to 60 Pounds, generally requiring about 5 Pounds of Powder for the Charge. They are also used in Countermines to break through into the Enemy's Galleries, and to disappoint their Mines.

PHÆNOMENON, in Natural Philosophy, signifies any Appearance, Effect, or Operation of a Natural Body, which offers itself to the Consideration and Solution of an Enquirer into Nature.

PHASES, signifies the Appearance, or the Manner of Things shewing themselves; and therefore in Astronomy is used for the several Positions, in which the Planets (especially the Moon) appear to our Sight; as obscure, horned, half-illuminated, or full of Light, which, by the Help of a Telescope, may likewise be observed in *Venus* and *Mars*.

PHROCYON, a fixed Star of the second Magnitude, in the Constellation *Canis Minor*, whose

Longitude is 111 Degrees, 23 Minutes, Latitude 15 Degrees, 57 Minutes.

PHYSICKS, or NATURAL PHILOSOPHY, is the speculative Knowledge of all Natural Bodies, and of their proper Natures, Constitutions, Powers, and Operations.

PHYSIOLOGY, PHYSICKS, or NATURAL PHILOSOPHY, is the Science of natural Bodies, and their various Affections, Motions, and Operations. This is either

1. *General*, which relates to the Properties and Affections of Matter or Body in general. Or,

2. *Special and Particular*, which considers Matter as formed or distinguished into such and such Species, or determinate Combinations

3. Mr. Keil, in his *Introductio ad Physicam*, reckons four Classes or Sorts of Philosophers, which have treated of Physicks or natural Philosophy.

4. Those who delivered the Properties of natural Bodies under Geometrical and Numeral Symbols, as the *Pythagoreans* and *Platonists*.

5. The *Peripateticks*, who explained the Natures of Things by Matter, Form, and Privation; by Elementary and Occult Qualities; by Sympathies, Antipathies, Faculties, and Attraction, &c. and these did not so much endeavour to find out the true Reasons and Causes of Things, as to give them proper Names and Terms; so that their Physicks is a kind of Metaphysicks.

6. The *Experimental Philosophers*, who by frequent and well-made Trials and Experiments, as by Chymistry, &c. sought into the Natures and Causes of

Things: And to these almost all our Discoveries and Improvements are due; and much more would they have done, if they had not fallen into *Theories* and *Hypotheses*, which they forced oftentimes their Experiments to maintain, whether they could or not.

7. The *Mechanical Philosophers*, who explicate all the *Phænomena* of Nature by Matter and Motion, by the Texture of Bodies, and the Figure of their Parts; by *Effluvia*, and other subtile Particles, &c. And, in short, wou'd account for all Effects and *Phænomena* by the known and established Laws of Motion and Mechanicks: And these are, in Conjunction with the last named, the only true Philosophers.

PICKET, in Fortification, is sometimes us'd for a Stake, sharp at one End, to mark out the Ground and Angles of a Fortification, when the Engineer is laying down the Plane of it; these are usually pointed with Iron: There are also larger Pickets, which are drove into the Earth, to hold together Fascines or Faggots, in any Work cast up in haste. And Pickets also are Stakes drove into the Ground by the Tents of the Horse in a Camp, to tie their Horses to. And Pickets are also drove into the Ground before the Tents of the Foot, where they rest their Muskets or Pikes round about them in a Ring. When a Horseman hath committed some considerable Offence, he is often sentenc'd to stand on the Picket; which is to have one Hand drawn up as high as it

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it can be stretch'd, and then he is to stand on the Point of a Picket or Stake only with the Toe of his opposite Foot; so that he can neither stand or hang well, nor ease himself by changing Feet.

PIEDOUCHE, in Architecture, is a little square Base smoothed, and wrought with Mouldings, which serves to support a Bust or Statue drawn half-way, or any small Figure in Relief.

PIED-DROIT, in Architecture, is a square Pillar, differing from a Pillaster, in this Respect, that it hath no Base or Capital: It is taken also for a Part of the Jaumbs of a Door or Window.

PILASTER, in Architecture, is a kind of a square Column, sometimes standing free, and detach'd from the Wall but more usually contiguous to it, or let within it, so as it does not shew above one fourth or fifth Part of its Thickness. The Pilaster is different in several Orders, and borrows occasionally the Name of each; having the same Ornaments and the same Proportions with the Columns.

PILLAR, in Architecture, is a kind of a round Column disengaged from any Wall, and made without any Proportion; being always either too massive or too slender: Such are the Pillars which support the Vaults of *Gothick* Buildings.

PINION, in a Watch, is that lesser Wheel which plays in the Teeth of another. Its Notches, (which are commonly 4, 5, 6, 8, &c.) are call'd *Leaves*, and not *Teeth*, as in other Wheels.

The Quotient or Number of Turns to be laid upon the Pinion of Report, is found by this

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Proportion: As the Beats in one Turn of the great Wheel, to the Beats in an Hour: So are the Hours of the Face of the Clock, (*viz.* 12, or 24.) to the Quotient of the Hour-wheel, or Dial-wheel, divided by the Pinion of Report, *i. e.* the Number of Turns which the Pinion of Report hath in one Turn of the Dial-wheel.

PIN-WHEEL. See *Striking-wheel*.

PISCES, is the twelfth and last Sign of the *Zodiac*, being a Constellation consisting of 35 Stars.

PISCIS MERIDIANUS, a Southern Constellation containing 12 Stars.

PLACE, is that Part of Space which any Body takes up; and with Relation to Space is either Absolute or Relative; as Mr. *Lock* observes.

2. **PLACE**, also is sometimes taken for that Portion of infinite Space, which is possess'd by, and comprehended within the material World, and which is thereby distinguish'd from the rest of the Expansion.

3. **PLACE** is usually distinguished into internal Place, which, properly speaking, is that Part of Space which any Body takes up and fills; and External Place, which, according to *Aristotle*, is determin'd by the Surfaces or Corfines of the adjoining or ambient Bodies: But it is better divided into Absolute, which is the former Internal Place; and into Relative Place, which is the apparent Secondary or sensible Position of any Body, according to the Determination of our Senses, with Respect to other contiguous or adjoining Bodies.

4. *Place of Arms*, when taken in the general, is a strong City which is pitched upon for the Magazine of any Army. But a Place in Fortification usually signifies the Body of a Fortress. And a

5. *Place of Arms in a Garrison*, is a large open Spot of Ground in the Middle of the City, where the great Streets meet, or else between the Ramparts and the Houses, for the Garrison to rendezvous in, upon any sudden Alarm, or other Occasion. And the

6. *Place of Arms of a Trench, or of an Attack*, is a Post near it, shelter'd by a Parapet or Epaulement, for Horse or Foot to be at their Arms, to make good the Trenches against the Sallies of the Enemy. These Places of Arms are sometimes cover'd by a Rideau or Rising-Ground, or else by a Cavin or deep Valley, which saves the Trouble of fortifying them by means of Parapets, Fascines, Gabions, &c. they are always open in the Rear, for their better Communication with the Camp. When the Trenches are carried on as far as to the Glacis, they make it very wide, that it may serve for a Place of Arms.

PLACE GEOMETRICK. See *Locus*.

PLACE PLANE. See *Locus Plane*.

PLACE SIMPLE. See *Locus Simple*.

PLACE SOLID. See *Locus Solid*.

PLACE SURSOLID. See *Locus Sursolid*.

PLACE of the Sun, Star, or Planet, is the Sign of the Zodiac, Degree, Minute, and Se-

cond of it, which the Planet is in; or it is that Degree of the Ecliptick reckon'd from the Beginning of *Aries*, which the Planets or Stars Circle of Longitude cutteth; and therefore is often call'd, the *Longitude of the Sun, Planet, or Star*.

PLAIN ANGLE. See *Angle*.

1. *Sides of a plain Angle*, are the Lines forming it.

2. *Vertex of any Angle*, are the Points wherein the Lines forming it meet.

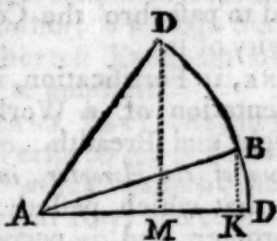
3. *Measure of a plain right-lin'd Angle*, is an Arch of a Circle describ'd about the Vertex, contain'd between the Sides of the Angle.

4. *Equal right-lin'd Angles*, are such whereof the Area's of Circles describ'd from their Vertices, and intercepted between their Sides, are proportional to their Radii, or, which is the same Thing, do contain the same Number of Degrees.

5. *Euc. in Prop. 9. lib. 1.* has taught us how to bisect or divide any given right-lin'd Angle into two equal Parts, and from thence it will be easy to divide it into 4, 8, 16, 32, 64. &c. equal Parts.

6. But the Antients, as we learn from *Pappus* in his mathematical Collections, cou'd not bisect or divide an Angle given into three equal Parts by a straight Line and a Circle, and when they found it cou'd not be done this Way, they began to consider the Properties of other Curves, and found the Thing cou'd be done by the Conchoid, Cissoid, or Conick Sections. But *Archimedes*, *Pappus*, and Sir *Isaac Newton*, approve of the Conchoid for effecting this Business. And,

7. Sir Isaac Newton in Prob. 14. *Arit. univer.* shews how to divide an Angle into any given Number of equal Parts, but here the following Equations must be first solved. For if the given Angle be DAD , and EAD be the sought Angle that is to be any given



Part thereof, and the Radius AD be call'd r , the Sine DM of the given Angle q , and the Sine Complement AK of the sought Angle x : Then the Bisection of the given Angle will be had by the Resolution of this Equation, $xx - 2rr = qr$; the Trisection by the Resolution of this $xxx - 3rrx = qr^2$; the Quadrisection, by the Resolution of this $x^4 - 4rrxx + 2r^4 = qr^3$; the Quinisection, by the Resolution of this $x^5 - 5r^2x^3 + 5r^4x = qr^4$, &c.

PLAIN CHART, is the Plat or Chart that Seamen sail by, whose Degrees of Longitude and Latitude are made of the same Length.

PLAIN SAILING, is the Art of finding all the Varieties of the Ship's Motion on a Plain, where all the Meridians are made parallel, and the Parallels at Right Angles with the Meridians, and the Degrees of each Parallel equal to those of the Equinoctial; which tho' notoriously false in it self, supposing the Earth and Sea to be a plane Flatness, and each Parallel equal to the Equinoctial; yet by laying down

Places accordingly, and breaking a long Voyage into many short ones, a Voyage may pretty well be perform'd by it near the same Meridian.

In Plain Sailing 'tis imagin'd, that by the Rhumb-Line, Meridian, and Parallel of Latitude, there always will be form'd a Right-angled Triangle; and that so posited, as that the Perpendicular may represent Part of the Meridian or *North* and *South* Line, containing the Difference of Latitude: The Base of the Triangle represents the Departure, and the Hypotenuse the Distance sailed; the Angle at the Top is the Course, and the Angle at the Base the Complement of the Course; any two of which, with the Right Angle being given, the Triangle may be protracted, and the other three Parts found.

PLAIN SCALE, is a thin Ruler, either of Wood or Brass, whereon are graduated the Lines of Chords, Sines, Tangents, Secants, Leagues, Rhumbs, &c. and is of ready Use in most Parts of the Mathematicks, chiefly in Navigation.

PLAIN TABLE, is an Instrument used in surveying of Land.

1. The Table it self is a Parallelogram of Wood, 14 Inches and a half long, and 11 Inches broad, or thereabouts.

2. A Frame of Wood fixed to it, so as a Sheet of Paper being laid on the Table, and the Frame being forc'd down upon it, squeezeth in all the Edges, and makes it lie firm and even, so as a Plot may be conveniently drawn upon it. Upon one Side of this Frame should be equal Divisions for drawing Parallel Lines

Lines both long-ways and cros-ways (as Occasion may require) over your Paper; and on the other Side the 360 Degrees of a Circle, projected from a Brass Centre conveniently placed in the Table.

3. A Box with a Needle and Card, to be fix'd with 2 Screws to the Table; very useful for placing the Instrument in the same Position upon every Remove.

4. A Three-legged Staff to support it, the Head being made so as to fill the Socket of the Table, yet so as the Table may be easily turn'd round upon it, when 'tis fix'd by the Screw.

5. An Index, which is a large Ruler of Wood, (or Brass) at the least 16 Inches long, and 2 Inches broad, and so thick as to make it strong and firm; having a sloped Edge, call'd the *Fiducial Edge*, and two Sights of one Height, (whereof the one hath a Slit above, and a Thread below,) so set in the Ruler, as to be perfectly of the same Distance from the Fiducial Edge. Upon this Index 'tis usual to have many Scales of equal Parts, as also Diagonals, and Lines of Cords.

PLANCERE, in Architecture, is the under Part of the Roof of a Corona; which is the superior Part of the Cornice, between two Cymatiums. See those Words,

PLANE of a Dial, is the Surface on which any Dial is suppos'd to be describ'd.

PLANE GEOMETRICAL, in Perspective, is a plane Surface, parallel to the Horizon, placed lower than the Eye; wherein the visible Objects are imagin'd without any Alteration, except

that they are sometimes reduc'd from a greater to a lesser Size.

PLANE HORIZONTAL, in Perspective, is a Plane which is parallel to the Horizon, and which passes thro' the Eye, or hath the Eye suppos'd to be plac'd in it.

PLANE of Gravitation, or Gravity in any heavy Body, is a Plane suppos'd to pass thro' the Centre of Gravity of it.

PLANE, in Fortification, is the Representation of a Work in its Height and Breadth.

PLANE of the Horopter, in Opticks, is that which passeth thro' the Horopter, and is perpendicular to the Plane of the two optical Axes.

PLANE NUMBER, is that which may be produced by the Multiplication of two Numbers one in another; thus 6 is a plane Number, because it may be produc'd by the Multiplication of 3 by 2; for twice 3 makes 6. So also 15 is a plane Number, arising from 5 being multiply'd by 3: And 9 is a plane Number, produc'd by the Multiplication of 3 by 3.

PLANE PROBLEM, in Mathematicks, is such an one as cannot be solv'd Geometrically, but by the Intersection, either of a Right Line and a Circle; or of the Circumference of two Circles: As having the greater Side given, and the Sum of the other two, of a Right-angled Triangle; to find the Triangle. To describe a Trapezium that shall make a given Area of four given Lines. And such a Right Line can cut a Circle, or one Circle another but in two Points.

PLANE of Reflection, in Catoptricks, is that which passeth thro' the Point of Reflection, and is always

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PLANE of Refraction, is a Surface drawn thro' the incident and refracted Ray.

PLANE SURFACE, is that which lise even between its bounding Lines ; and as a right Line is the shortest Extension from one Point to another, so a plain Surface is the shortest Extension from one Line to another.

PLANE VERTICAL, in Opticks and Perspective, is a plane Surface which passeth along the principal Ray, and consequently thro' the Eye, and is perpendicular to the Geometrical Plane.

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PLANIMETRY, the same with *Planometria*. Which see.

PLANISPHERE, signifies the Circles of the Sphere describ'd in *Plano*, or on a Plane ; or it is a Plane or flat Projection of the Sphere. And thus the Maps either of Heaven or Earth are call'd *Planispheres* ; as also

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PLUMB-

PLUMB-LINE, the same with *Perpendicular*.

PNEUMATICKS, is the Doctrine of the Gravitation and Pressure of elastick or compressible Fluids.

PNEUMATICK ENGINE, the same with the *Air Pump*.

POETICAL, Rising and Setting of the Stars: This is peculiar to the antient poetical Writers; for they refer the Rising and Setting of the Stars, always to that of the Sun; and accordingly make three Sorts of Poetical Risings and Settings. *Cosmical*, *Acronical*, (or as some write it, *Acronyctal*;) and *Heliacal*. See those Words.

POINT, in Geometry, is that which is supposed to have neither Breadth, Length, or Thickness, but is indivisible.

1. The Ends or Extremities of Lines are Points.

2. If a Point be supposed to be mov'd any Way, it will by its Motion describe a Line.

POINT-BLANK, a Term in Gunnery, signifying that a Shot or Bullet goes directly forward to the Mark, and doth not move in a Curve as Bombs and highly elevated Random Shots do.

POINT of the Compass, in Navigation signifies 11 Degrees and 45 Minutes, or one 32^d Part of the Compass: The Half of which is 5 Degrees and 38 Minutes, which they call a *Half Point*; and the half of this, which is 2 Degrees and 49 Minutes, they call a *Quarter Point*.

The Seamen also call the Extremity of any Promontory, (which is a Piece of Land running out into the Sea) a *Point*; which is of much the same Sense with them as the Word *Cape*.

They say two Points of Land are one in another, when the Innermost is hinder'd from being seen by the Outermost.

POINT of Concourse, in Opticks, is that Point where the Visual Rays, being reciprocally inclin'd, and sufficiently prolong'd, meet together, are united in the Middle, and cross the Axis. This Point is most usually call'd the *Focus*; and sometimes the *Point of Convergence*.

POINT of Concurrence, a Term in Perspective. See *Principal Point*.

POINT of Divergence. See *Virtual Focus*.

POINT of Distance, is a Point in the Horizontal Line, so far distant from the principal Point as the Eye is remote from the same.

POINT of Sight. See *Principal Point*.

POINT of Incidence, in Opticks, is that Point on the Surface of a Glass, or other Body, on which any Ray of Light falls: And as some express themselves, it is that Point of the Glass, which a Ray parts from, after its Refraction, and when 'tis returning into the Rare Medium again.

POINT of Inflexion of a Curve. See *Inflexion*.

POLAR DYALS, are those whose Planes are parallel to some great Circle that passes thro' the Poles, or parallel to some one of the Hours; so that the Pole is neither elevated above, nor depress'd below the Plane; therefore the Dial can have no Centre, and consequently its Stile, Substile, and Hour-Lines, are parallel. This therefore will be an Horizontal Dial to those that live under the Equator or Line.

1. In a direct Polar Dial, the Hour-Lines must be drawn all parallel to the Hour-Line of Twelve.

2. The Style may be either a straight Pin set upright, or a Wire made to lie parallel to the Plane; and must stand over the Hour-Line of Twelve.

3. The Length of the Plane may be taken in any Inches, or Parts of Inches, reckoning the Inch to be divided into 10, or 100 equal Parts of the Style.

4. Then for Height.

5. As the Tangent of the Hour-Line 4 or 5, is to the Logarithm of their Distance from the Meridian in Inches and Parts:

6. So is the Radius, to the Height of the Stile in Inches and Parts.

7. For the Hour-Lines.

8. As the Radius is to the Logarithm of the Stile's Height, in Parts of Inches:

9. So is the Tangent of any Hour-Line, to the Logarithm of the Distance thereof from the Meridian Line.

POLAR PROJECTION, is a Representation of the Earth, or of the Heavens, projected on the Plane of one of the Polar Circles.

POLARITY, is the Property of the Magnet, or of a Piece of oblong Iron touch'd by a Magnet, to point towards the Poles of the World.

POLE, in *Measuring* is the same with *Perch* or *Rod*.

POLE, in *Mathematicks*, is a Point 90 Degrees distant from the Plane of any Circle, and in a Line perpendicularly erected in its Centre; which Line is call'd the *Axis*. And from this Polar Point may Circles be de-

scrib'd on the Globe or Sphere, as they are on the Plane from their Centre.

POLE-STAR, is a Star in the Tail of the little Bear, (a Constellation of 7 Stars, which is call'd *Cynosura*,) and is very near the exact North Pole of the World.

POLE of a *Glass*, in Opticks, is the thickest Part of a Convex, but the thinnest of a Concave Glass; and if the Glass be truly ground, will be exactly in the Middle of its Surface. This is sometimes call'd, the *Vertex* of the Glass.

POLES of the *World*, are two Points in the Axis of the *Æquator*, each 90 Degrees distant from its Plane; one pointing North, which therefore is call'd, the *North* or *Arctic Pole*; the other Southward, which therefore is call'd, the *South* or *Antarctic Pole*.

Whether any People live directly under the Pole or not, is a Question; but Mr. *Halley* hath proved, that the solstitial Day under the Pole, is as hot as under the Equinoctial, when the Sun is vertical to them, or in their Zenith; because for all the 24 Hours of that Day under the Pole, the Sun's Beams are inclin'd to the Horizon with an Angle of $23\frac{1}{2}$ Degrees: Whereas under the Equinoctial, tho' he become vertical, yet he shines no more than 12 Hours, and is absent 12 Hours. And besides, for 3 Hours 8 Minutes of that 12 Hours he is above the Horizon there, he is not so much elevated as under the Pole.

POLES of the *Ecliptick*, are Points in the solstitial Colure 23 Degrees and 30 Minutes distant,

stant from the Poles of the World; and thro' these all Circles of Longitude in the Heavens do pass, as the Hour-Circles do thro' the Poles of the Æquator.

POLLUX, a fix'd Star in the Twins of the second Magnitude, whose Longitude is 108 Degrees and 47 Minutes, Latitude 6 Degrees and 38 Minutes.

POLYACOUSTICKS, are Instruments contriv'd to multiply Sounds, as Multiplying-Glasses or Polyscopes do Images of Objects.

POLYEDRON, the same with *Polyhedron*

POLYGON, a Term in Geometry, signifying in the general any Figure of many Sides and Angles, tho' no Figure is call'd by that Name, unless it have more than four or five Sides.

1. Every Polygon may be divided into as many Triangles as it hath Sides.

2. The Angles of any Polygon taken together, will make twice as many Right ones, except four, as the Figure hath Sides.

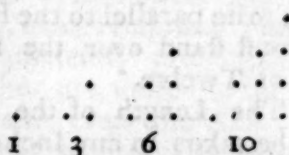
3. Every Polygon circumscrib'd about a Circle, is equal to a rectangled Triangle, one of whose Legs shall be the Radius of the Circle, and the other the Perimeter (or Sum of all the Sides) of the Polygon.

POLYGON EXTERIOR, in Fortification, is the Distance of one Point of a Bastion from the Point of another, reckon'd all round the Work.

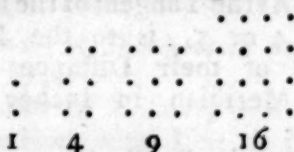
POLYGON INTERIOR, is the Distance between the Centres of any two Bastions, reckon'd all round as before.

POLYGONAL NUMBERS, are such as are the Sums or Aggre-

gates of Series of Numbers in Arithmetical Progression, beginning with Unity; and so placed that they represent the Form of a Polygon. Thus,



are triangular Numbers, because they are the Aggregates of a certain Number of Points plac'd in the Form of Triangles, &c.



are Quadrangular Numbers, &c.

If the Side of a Polygonal Number be $=n$, and the Number of Angles be $=a$, and the first Term $=1$. then the Sum of a Series of Triangular Numbers will be,

$$\text{Triangular } \frac{n^3 + 3n^2 + 2n}{6}$$

$$\text{Of Pentagonal, } \frac{n^3 + n^2}{2}$$

$$\text{Of Hexagonal, } \frac{4n^3 + 3n^2 - n}{6}$$

$$\text{Of Septagonal, } \frac{5n^3 + 3n^2 - 2n}{6}$$

$$\text{Of Octogonal, } \frac{2n^3 + n^2 - n}{2}$$

POLYGRAM, is a Geometrical Figure consisting of many Lines.

POLYHEDROUS FIGURE, in Geometry, is a Solid contained under or consisting of many Sides; which, if they are regular Polygons, all similar and equal, and the Body be inscribable within the Surface of the Sphere, 'tis then call'd a *Regular Body*. See that Word.

POLY-

P O

POLYNOMIAL, or *Multinomial Roots*, in Mathematicks, are such as are compos'd of many Names, Parts, or Members; as $a+b+d+e$.

POLYSCOPES, or *Multiplying Glasses*, are such as represent to the Eye one Object as many.

POLYSPASTIUM, a Term in Mechanicks, the same with the Trochlea or Pulley.

PONTON, in Fortification, is a Bridge made of Two Boats, at some Distance one from another, both cover'd with Planks; as also the internal Space betwixt them. They have Props and Rails on each Side; and the whole Structure ought to be solid, as to be able to transport the Horse, together with Cannon and Baggage, as well as the Infantry.

PONT VOLANT, or *the Flying Bridge us'd in Sieges*, is made of two small Bridges laid one over another, and so contriv'd by the Means of Cords and Pulleys placed along the Sides of the under Bridge, that the Upper can be push'd forwards till it joins the Place where it is to be fix'd; but however the whole Length of both these Bridges must not be above four or five Fathom long, lest they should break with the Weight of the Men. These are chiefly used to surprize Outworks or Posts that have but narrow Moats.

PORES, are small Interstices, Spaces or Vacuities between the Particles of Matter that constitute every Body, or between certain Aggregates or Combinations of them.

Mr. Boyle has written a particular Essay on the Porosity of Bodies, in which he proves, that

P O

the most solid Bodies that are, have some kind of Pores: And indeed, if they had not, all Bodies would be alike specifically weighty.

PORIME, (*Gr. πόριμα*) in Geometry, is a Theorem, or Proposition so easy to be demonstrated, that 'tis almost self-evident; as, that a Chord is all of it within the Circle. And on the contrary, they call that an *Aporime*, which is so difficult as to be almost impossible to be demonstrated; as the Squaring of any assign'd Portion of *Hippocrates's Lunes* was, till a little while ago.

PORISME, *Proclus* and *Pappus* define this Geometrical Term to signify a kind of Theorem, in the Form of a Corollary, which is dependant upon, or deduced from some other Theorem already demonstrated. And 'tis commonly used to signify some general Theorem, which is discover'd from finding out some Geometrical Place: As, for Instance: If a Man hath found out by Algebra, or any other Method, how to construct a Local Problem; and from that Place so constructed and demonstrated, hath deduc'd some general Theorem, that Theorem is by the Geometrick Writers call'd a *Porisme*.

PORISTICK METHOD, in Mathematicks, is that which determines when, by what Way, and how many different Ways a Problem may be resolved.

PORTCULLICE, *Herse*, or *Sarazine*, in Fortification, signifies several great Pieces of Wood laid or join'd across one another like an Harson, and at the Bottom it is pointed at the End of each

Bar

Bar with Iron; these formerly used to hang over the Gate-ways of fortify'd Places, to be ready to let down in case of a Surprize, when the Enemy should come so soon, as that there is no Time to shut up the Gates: But now a-days the Orgues are more generally used, as being found to be much better. See *Orgues*.

PORTICO, in Architecture, is a kind of Gallery raised upon Arches, where People walk under Shelter. It has sometimes a Soffit or Ceiling, but is more commonly vaulted. Tho' the Word *Portico* be deriv'd from *Port* or *Gate*, yet do we call the whole Disposition of the Columns in the Gallery by this Name. The most celebrated Portico's of Antiquity were those of the Temple of *Solomon*, that of *Athens* built for the People to divert themselves in, and where the Philosophers held their Conversation, that which occasion'd the Disciples of *Zeno* to be call'd *Stoicks* from the *Greek Stoa*, a Portico, that magnificent one of *Pompey* at *Rome*, and that of *St. Peter's* Palace in the *Vatican*.

POSITION, or SITE, is an Affection of Place, and expresses the Manner of any Body's being in a Place: This therefore is not Place, nor indeed hath it any Quantity; as *Sir Isaac Newton* well observes in *Princip. Mathem.* p. 6.

POSITION, or the Rule of Position, otherwise called the Rule of Falshood, is a Rule in Arithmetick, wherein any Number is taken to work the Question by, instead of the Number sought; and so by the Error or Errors found, we find the Number required.

This Rule of false Position is of two Kinds, viz. Single and Double.

POSITION SINGLE, is when there happens in the Proposition some Partition of Numbers into Parts proportional, and then at one Operation the Question may be resolved by this Rule.

Imagine a Number at pleasure, and work therewith according to the Tenor of the Question; if it were the true Number, and what Proportion there is between the false Conclusion, and the false Position; such Proportion hath the given Number to the Number sought: Therefore, the Number found by Argumentation shall be the first Term of the Rule of *Three*, and the Number supposed shall be the second Term, and the given Number shall be the third Term.

POSITION DOUBLE, is when there can be no Partition in the Numbers to make a Proportion: Therefore, you must make a Supposition twice, proceeding therein according to the Tenor of the Question; and if either of the supposed Numbers happens to solve the Proposition, the Work is done; but if not, observe the Errors, and whether they be greater or lesser than the Resolution requireth; and mark the Errors accordingly, with the Signs $+$ or $-$.

Then multiply contrariwise the one Position by the other Error; and if the Errors be both too great, or both too little, subtract the one Product from the other, and the one Error from the other, and divide the Difference of the Products by the Difference of the Errors.

But,

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But, if the Errors be unlike, as the one $+$, and the other $-$, add the Products, and divide the Sum thereof by the Sum of the Errors added together: For the Proportion of the Errors, is the same with the Proportion of the Excesses or Defects of the Numbers supposed, to the Numbers sought.

POSITIVE QUANTITIES, in Algebra, are such as are of a Real and Affirmative Nature, and either have, or are supposed to have the Affirmative or Positive Sign $+$ before them, and 'tis always used in Opposition to the Negative Quantities, which are defective, and have this Sign $-$ before them.

POSTERN, in Fortification, is a False-Door usually made in the Angle of the Flank, and of the Curtain, or near the Orillon, for private Sallies.

POSTICUM, is the Postern-Gate, or Back-Door of any Fabric.

POSTULATES, or DEMANDS, in Mathematicks, &c. are such easy and self-evident Suppositions, as need no Explication or Illustration to render them intelligible. As,

That a Right Line may be drawn from one Point to another. That a Circle may be described on any Centre given, of any Magnitude, &c.

POTANS, or POTENCE, a Part of a Watch; see under *Balance*.

POWERS, in Algebra, are Numbers arising from the Squaring or Multiplication of any Number or Quantity by it self, and then that Product by the Root or first Number again; and this third Product by the Root again;

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and so on *ad infinitum*; as 2, 4, 8, 16, 32, 64, 128, 256, &c. Where 2 is called the Root or first Power, 4 is the Square or second Power, 8 is the Cube or third Power, 16 the Biquadrat or fourth Power, &c. And these Powers in Letters or Species, are express'd by repeating the Root as often as the Index of the Power expresses; thus, a is the Root or first Power, aa the Square or second Power, aaa the Cube, $aaaa$ the Biquadrat or fourth Power. And to avoid the Tedioufness of repeating the Root so often when the Powers are high, we only put down the Root with the Index of the Power over it, thus; a^9 , that is the ninth Power of a ; b^{16} , b^{94} , are the sixteenth and the ninety-fourth Powers of b .

POWER of an HYPERBOLA, is the 16th Part of the Square of the Conjugate Axis, or the $\frac{1}{4}$ Part of the Square of the Semi-conjugate Axis; or it is equal to a Rectangle under the $\frac{1}{4}$ of the Transverse Axis, and $\frac{1}{4}$ Part of the Sum of the Transverse Axis, and Parameter.

3. **Powers of Lines, or Quantities**, are their Squares, Cubes, &c. or other Multiplications of the Parts into the Whole, or of one Part into another.

PRACTICE, in Arithmetick, is a Rule which expeditiously and commodiously answers Questions in the *Rule of Three*, when the first Term is 1, or Unity; and 'tis so call'd from its Readiness in the Practice of Trade and Merchandize.

PRECESSION of the Equinox. Because in reality the Axis of the Earth doth a little vary from such an exact Parallelism, and doth not

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point

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point always precisely to the same Star when it is in the same Place: Hence it happens that the Equinoctial Points, or the common Interfection of the Equator and Ecliptick, do retrocede or move backward from East to West, about 50 Seconds each Year; and this Motion backwards is by some call'd the *Recession of the Equinox*, by others the *Retrocession*; and the advancing of the Equinoxes forward by this Means is called the *Precession* of them.

PRELUDE, in Musick, signifies any Flourish, that is introductory to Musick which is to follow after.

PRIEST'S CAP, a Term in Fortification. See *Bonnet a Pretre*.

PRICK. To prick the Chart or Plot at Sea, signifies to make a Point in their Chart whereabouts the Ship is now, or is to be at such a Time, in order to find the Course they are to steer, &c.

PRIMARY PLANETS, are those Six that revolve about the Sun, viz. *Mercury, Venus, the Earth, Mars, Jupiter, and Saturn*.

PRIME FIGURE, is that which cannot be divided into any other Figures more simple than it self; as a Triangle in Planes, the Pyramid in Solids: For all Planes are made of the First, and all Bodies or Solids compounded of the Second.

PRIME NUMBERS, in Arithmetick, are those made only by Addition, or the Collection of Unites, and not by Multiplication: So an Unite only can measure it; as 2, 3, 4, 5, &c. and is by some call'd a *Simple*, and by others an *Uncompound Number*.

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PRIME VERTICALS, or *Direct, Erect, North or South Dials*, are those whose Planes lie parallel to the Prime Vertical Circle, which is that perpendicular to the Horizon, and passing thro' the East and West Points of it.

PRIMING-IRON, is a small sharp Iron which is thrust into the Touch-hole of a Great Gun, and pierces into the Cartridge that holds the Powder or Touch-Powder to fire off the Piece.

PRIMUM MOBILE, in the *Ptolemaick Astronomy*, is suppos'd to be a vast Sphere, whose Centre is that of the World, and in Comparison of which the Earth is but a Point: This they will have to contain all other Spheres within it, and to give Motion to them, turning it self and all of them quite round in twenty four Hours.

PRINCIPAL RAY, in Perspective, is the perpendicular one which goes from the Spectator's Eye to the vertical Plane, or the Picture. And the Point where this Ray falls on the Picture, is called from hence, the

PRINCIPAL POINT, and is that Point of the Picture wherein a Ray drawn perpendicular to it cuts it.

PRISM, is a solid Figure, contained under several Planes, whose Bases are Polygons, equal, parallel, and alike situated.

1. *Prism, in Opticks*, is a Glass bounded with two equal and parallel triangular Ends, and three plane and well polished Sides, which meet in three Parallel Lines, running from the three Angles of one End, to those of the other, and is used in Opticks to make many noble

noble and curious Experiments about Light and Colours: For the Rays of the Sun falling upon it at a certain Angle, do transmit thro' it a Spectrum or Appearance, colour'd like the Iris or Rainbow in the Heavens.

2. The Surface of a Right Prism, is equal to a Parallelogram of the same Height, having for its Base a Right Line equal to the Periphery of the Prism.

3. All Prisms are to one another in a Ratio compounded of their Bases and Heights.

4. All like Prisms are to one another in the Triplicate Ratio of their answerable Sides.

5. A Prism is the Triple of a Pyramid of the same Base and Height.

PRISMOID, is a solid Figure, contained under several Planes, whose Bases are Rectangular Parallelograms, parallel and alike situate.

PROBLEM, is a Proposition which relates to Practice; or which proposes something to be done: As to make a Circle pass through three given Points not lying in a Right Line; to find the Compass, &c.

PRODUCE, a Term in Geometry, signifying to continue a Right Line, or draw it out farther, till it have any assigned Length.

PRODUCT, is the Quantity arising from, or produced by the Multiplication of 2 or more Numbers, Lines, &c. into one another; thus, if 6 be multiplied by 8, the Product is 48. In Lines, 'tis always, (and sometimes in Numbers,) call'd the *Rectangle* between the two Lines that are multiply'd one by another. See *Rectangle*.

PROFILE, in Architecture, is the Contour, or Out-line of any Member, as that of the Base, a Cornice, or the like. Or it is more properly a Prospect of any Place, City, or Piece of Architecture, viewed Side-ways, and express'd according to the Rules of Perspective.

PROGRESSION ARITHMETICAL. See *Arithmetical Progression*.

PROGRESSION GEOMETRICAL, or *Geometrical Proportion continu'd*, is when Numbers, or other Quantities, proceed by equal Proportion or Ratio's, (properly called,) that is, according to one common Ratio whether Increasing or Decreasing. As

1. 2, 4, 8, 16, 32, 64, &c.

2. If there are never so many continual Proportionals, the Product of any two Extremes is equal to the Product of any two Means that are equally distant from the Extremes, as also to the Square of the Mean, or middle Term, if the Number of the Terms be odd.

3. If the first and last Terms, and the Ratio in any Geometrical Progression be given, and the Sum of all the Terms be required, multiply the second and last Terms together, and from the Product subtract the Square of the first Term; and then divide the Remainder by the Difference between the first and second Term, and the Quotient will be the Sum of all the Terms.

4. Any infinite Series of Fractions decreasing according to the Proportion of the Denominator of the last Term, and having a common Numerator less by an Unite than the Denominator of the last Term, is equal to Unity.

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PROJECTILES, are such Bodies as being put into a violent Motion by any great Force, are then cast off or let go from the Place where they received their Quantity of Motion, and do afterwards move at a Distance from it; as a Stone thrown out of ones Hand by a Sling, an Arrow from a Bow, a Bullet from a Gun, &c.

1. The Line of Motion which a Body projected describes, abstracting from the Resistance of the Medium, is, as hath been proved by *Gailiens*, and many others; and particularly by Sir *Isaac Newton*, Proposition 4, Cor. 1. of his Second Book, the Curve of a Parabola, which Line is also described by every descending Body. He shews also, that if the Line of Direction of the Projectile Motion of any Body, the Degree of its Velocity, and at the Beginning, the Resistance of the Medium being given, the Curve which it will describe may be discover'd, and *Vice Versa*. He saith also in *Schol. Prop. X. Lib. 2.* that the Line which a Projectile describes in a Medium uniformly resisting the Motion, rather approaches to any Hyperbola than a Parabola.

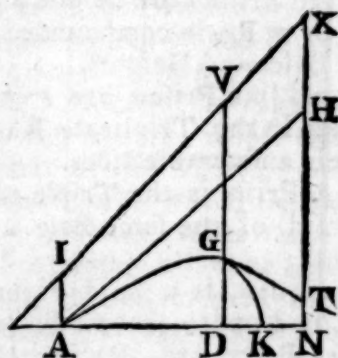
2. The Horizontal Distances of Projections made with the same Velocity at several Elevations of the Line of Direction, are as the Sines of the Double Angles of Elevation.

3. The Velocities of Projectiles, in the several Points of a Curve, are as the Lengths of the Tangents to the Parabola in those Points, intercepted between any two Diameters: And these again are as the Secants of the Angles, which those Tangents con-

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tinu'd make with the Horizontal Line.

4. If *AGK* be a Curve of the Hyperbolick Kind one of whose Asymptotes is *NX*, perpendicular to the Horizon *AK*, and the other *MX* inclin'd to the same, where *VG* is reciprocally as *DN* whose Index is *n*: This Curve will nearer represent the Path of a Projectile thrown in



the Direction *AH* in our Air, which may be taken as a Uniform Medium, resisting Bodies as the Squares of their Velocities, than a Parabola which is only describ'd by a Projectile, where there is no Medium resisting its Motion. Sir *Isaac Newton* in the 2d Book of his *Principia*, says indeed, That these Hyperbola's are not accurately the Curves that a Projectile makes in the Air; for the true one is a Curve, which about the Vertex is more distant from its Asymptotes, and in those Parts remote from the Axis approaches nearer to the Asymptotes than these Hyperbola's; but in Practice these Hyperbola's may be us'd instead of these more compound ones. And if a Body be projected from the Place *A*, according to the Right Line *AC*, and

A I

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AI be drawn parallel to the Asymtote NX, and GT is a Tangent to the Curve, (in the Vertex:) Then the Density of the Medium in A will be reciprocally as the Tangent AH, which if it had been a standing Quantity, the Medium would have had a given Density as our Air may be said to have, so far as Projectiles can move in it, and the Body's Velocity will be as $\sqrt{\frac{AH^2}{AI}}$ and the Resistance thence to Gravity, as AH to $\frac{2nn+2n}{2+n} \times AI$.

PROJECTION of the Sphere in Plano, is a true Geometrical Delineation of the Circles of the Sphere, or any assign'd Parts of them, upon the Plane of some one Circle; as on the Horizon, Meridian, Equator, Tropick, &c.

PROJECTION (MONSTROUS) of an Image, in Perspective, is the Deformation of an Image on a Plane, or the Superficies of some Body, which seen at a certain Distance will appear formous.

If it be required to delineate a monstrous Projection on a Plane, Proceed thus.

1. Make a Square ABCD (call'd the Craticular Prototype) of a Big-



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ness at pleasure, and divide the Side AB into a Number of equal Parts, that so the said Square may be divided into a Number of Areola's, or lesser Squares.

2. In this Square let the Image, to be represented deform'd, be drawn.

3. Draw the Line ab=AB, and divide it into the same Number of equal Parts, as the Side



of the Prototype AB is divided into.

4. In E, the Middle thereof, erect the Perpendicular EV, so much the longer, as the Deformation of the Image is to be greater.

U 3

5. Draw

5. Draw VS perpendicular to EV , so much the less in Length, as you would have the Image appear more deform'd.

6. From each Point of Division draw Straight Lines to V , and join the Points a and S , as also the Right Line aS .

7. Thro' the Points d, e, f, g , draw Right Lines parallel to $a b$. Then will $abcd$ be the Space that the *Monstrous Projection* is to be delineated in, call'd the *Craticular Estipe*.

8. In every Areola, or small Trapezium of this Space $abcd$; let there be drawn what appear delineated in the Correspondent Areola of the Square $ABCD$, and by this Means you will obtain a Deform'd Image, which will appear formous to an Eye distant from it by the Length FV , and raised above it the Height VS .

9. It will be very diverting to manage it so, that the Deform'd Image does not represent a mere Chaos; but some other Image different from it, which by this Contrivance shall be deformed. As I have seen a River with Soldiers, Waggon, &c. marching along the Side of it; so drawn, that when it is look'd at by an Eye in the Point S , appears to be the Satyrical Face of a Man.

10. An Image may be deform'd mechanically, if you place the Image, having little Holes here and there made in it with a Needle or Pin, against a Candle or Lamp, and observe where the Rays going thro' these little Holes fall on a Plane, or Curve-Superficies; for they will give the Correspondent Points of the Image deform'd, by which Means the Deformation may be compleated.

To draw the Deformation of an Image upon the Convex-Surface of a Cone.

From the last Problem it is manifest enough, that all that is to be done here, is to make the *Craticular Estipe* in the Superficies of the Cone, which shall appear to an Eye duly placed over the Vertex of it, equal to the *Craticular Prototype*. Therefore,

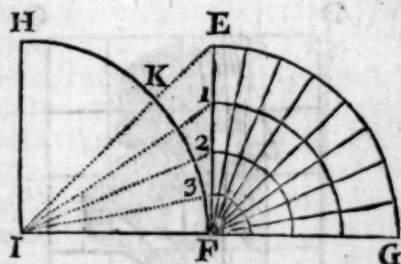
1. Let the Base $ABCD$ of the Cone, (Fig. 1.) be divided by Diameters into any Number of equal Parts; that is, let the Periphery be thus divided.

Fig. 1.



2. Likewise let some one Radius be divided into equal Parts, and thro' each Point of Division draw Concentrick Circles. And thus shall the *Craticular Prototype* be made.

3. With the Double of the Diameter AB , as a Radius, describe the Quadrant EFG , (Fig. 2.) so that the Arch EG may be e-



qual to the whole Periphery; then this Quadrant folded rightly up,

up, will form the Superficies of a Cone, whose Base is the Circle *ABCD*.

4. Divide the Arch *AB* into the same Number of equal Parts, as the *Craticular Prototype* is divided into, and draw Radii from each of the Points of Division.

5. Produce *GF* to *I*, so that *FI=FG*, and from the Centre *I*, with the Radius *IE*, draw the Quadrant *FKH*, and from *I* to *E* draw the Right Line *IE*.

6. Divide the Arch *KF* into the same Number of equal Parts, as the Radius of the *Craticular Prototype* is divided into, and draw Radii thro' each of the Points of Division from the Centre *I*, meeting *EF* in 1, 2, 3, &c.

7. Finally, from the Centre *F* with the Radii, *F1*, *F2*, *F3*, &c. describe Concentrick Arches. Thus will you have the *Craticular EType*, whereof each Areola will appear equal to one another.

8. Therefore, if what is delineated in every Areola of the *Craticular Prototype* be transferr'd into the Areola's of the *Craticular EType*, the Image will be deformed; but the Eye being duly raised over the Vertex of the Cone will perceive it formous.

9. If the Chords of the Quadrants be drawn in the *Craticular Prototype*, and Chords of their fourth Part in the *Craticular EType*, all Things else remaining the same; you will have the *Craticular EType* in a Quadrangular Pyramid. And from hence you may learn how to deform an Image in any other Pyramid, whose Base is any Regular Polygon.

10. Because the Eye will be

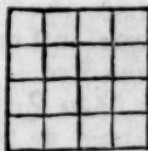
more deceived, if from contiguous Objects it cannot judge of the Distance of the Parts of the Deformed Image: Therefore, these kind of Deformed Images must be looked at thro' a small Hole.

To delineate a Figure in an Horizontal Plane, which shall appear by Reflexion on a Cylindrical Speculum standing on that Plane, like a Square divided into many little Square Areola's.

1. About *AB*, (Fig. 2.) the Diameter of the Cylindrical Speculum, describe a Circle equal to the Base of the Cylinder.

2. Take the Point *O* under the Eye, and draw the Tangents *OC*, *OB*; because no Ray reflected from the Speculum beyond them, will fall upon the Eye. Likewise the Right Lines *OB*, *OC*, may be so drawn, as to

Fig. 1.



cut the Circle; since what are perceived by the Tangents, will not be distinct enough.

3. Join the Points of Contact, or Intersection, *C*, *B*, by a Straight Line *CB*, which must be taken for the Side of the Square appearing in the Speculum. Because the Image appears in a Cylindrical Speculum between the Centre and the Superficies.

4. Divide *CB* into any Number of equal Parts; and from every of the Points of Division

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tion, 1, 2, 3, &c. draw Right Lines $O1, O2, O3, \&c.$ to the Point O under the Eye.



Fig. 2.



3. Let the Radii OH, OI , be reflected to the Points F, G , &c. that is, let HF, IG , be the Reflexion of $O1, O2, \&c.$

6. Upon the indefinite Right Line MQ raise the Perpendicular MP , equal in Length to the Height of the Eye.

7. From M to Q transfer the Line OH , and at Q raise the Perpendicular QR , which let be equal to the Side of the Square appearing in the Speculum, and



divide the same into the same Number of equal Parts, as that Side is divided into.

8. Thro' every Point of Di-

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vision, 1, 2, 3, &c. draw the Right Lines, $P.I, P.II, P.III, \&c.$

9. From L to $I, II, III, \&c.$ transfer the Right Lines $LI, LII, LIII, \&c.$ equal to $QI, QII, QIII, \&c.$

10. After the same Manner, let the Lines, $HF, IG, \&c.$ be divided; and thro' the Points of Division of the same Order draw Curves: Or, since there is no Need of very great Accuracy in these Cases, draw Circular Arches thro' three Points, as is done in the Figure.

I say the Figure $STFGA$, being erected upon the Circle $ACDB$, will appear in the Cylindrical Speculum, as a Square divided into several equal square Areola's. Whence, if a Square be made, whose Side is equal to QR , and the same be divided into equal Areola's, and in the same be painted any Image, and then what is in every Areola of it be transfer'd in the correspondent Areola's of the deform'd Square, that deform'd Image will by Reflexion appear formous in the Cylindrical Speculum.

To delineate a deform'd Figure upon an Horizontal Plane, that shall appear formous by the Reflexion of a Conical Speculum to an Eye over the Vertex.

1. The Image to be deform'd must be delineated in a Circle, equal to the Base of the Conical Speculum, and the Periphery



must be divided into equal Parts by the Diameters, $ad, be, cf, \&c.$

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Sec. and the Radii Ob , Oc , Od ,
&c. into equal Parts Oa , 1, 2, 2.3.
&c. by Concentrick Circles.

2. To get the Points *I, II, III,* &c. in the Plane that the Cone's Base stands upon, which are seen by reflected Rays within the Speculum at the Points, 1, 2, 3, &c. make a Right-angled Triangle, *AOE*, whose Base *OE* is



equal to the Radius of the Speculum, and Altitude AO equal to the Height of the Speculum, that is equal to its Axis. And in AO produced take AB equal to the Height of the Eye.

3. To every of the Points 1, 2, 3, &c. of Division from the Point B, wherein the Eye is suppos'd, draw the Right Lines, B1, B2, B3, &c.

Fig.



4. Because these are the reflected Rays by which the Points 1, 2, 3, &c. are seen, and AE is the Intersection of the Plane of Reflexion and the Speculum, make the Angles $I. DE$, $II. CE$, equal to the Angles BDA , BCA , &c. then shall $D. I$, $C. II$, &c. be the Rays of Incidence: Consequently $I. II$, &c. the radiating Points which are seen by Reflexion, in 1, 2, 3, &c.

PR

5. Therefore produce the Radii Oa , Ob , Oc , &c. in the *Craticular Prototype*, and transfer in them the Divisions *O.I*, *O.II*, *O.III*, &c. And lastly draw Concentrick Circles from the Point O , and thus will you have the *Craticular E&type*.

6. Therefore if in every of its Areola's you depict what you find in the correspondent Areola's of the *Craticular Prototype*, you will have a deform'd Figure, which will appear formous by Reflexion, to an Eye duly plac'd over the Vertex of the Cone.

*To delineate a deform'd Image upon
a Plane, that shall appear for-
mous by Reflexion to an Eye,
placed over the Vertex of a Pyra-
midal Speculum.*

For Example. Let it be requir'd to delineate a deform'd Image, which will appear formous by the Reflexion of a Quadrangular Pyramid.

1. In this Case, the Image to be deform'd, is to be delineated in the Square $ABCD$, equal to the Base of the Speculum, whose Perimeter must be divided into equal Parts by Diagonals, from the Centre E ; and also by Right

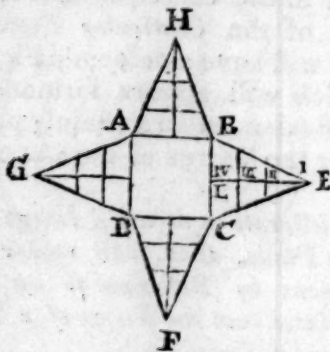


Lines, bisecting the Sides AB , BC , &c. Moreover, the Lines EL , EB , must be divided into any Number of equal Parts; so that Lines drawn thro' the Points of Division, which are parallel to the Sides of the Base, may include the *Craticular Prototype*.

2. Now,

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2. Now, since the Section of the Speculum thro' the Axis, and the Right Line EL drawn in the Base, is a Right-angled Triangle; and every Point of Division of the Craticular Prototype, is in the reflexed Ray, after the very same Manner as in the last Problem are found the Points $I, II, III, \&c.$ of the Axis LE , of the



Triangle *BEC*, to be reflected :
Which being given, the Tri-
angle itself may be made.

3. *Lastly*, What else is to be done, must be proceeded with, as in the last Problem.

Note, Deform'd Images, that are made by Means of Pyramidal Speculums, are more diverting than those made by others. Because the Parts of the Deform'd Image being disjoin'd, any others may be painted between them, forming one and the same continuous Thing with them without the Speculum, which in the Speculum will not be seen.

PROJECTURE, in Architecture, signifies the Prominency or Embossment, which the Mouldings, and other Members have, beyond the naked Wall ; and is always in Proportion to its Height. The Word is also apply'd to Galleries, Balconies, &c. which jett beyond the Face of the Wall.

P. R.

PROLATE SPHEROID, is a Solid produced by the Revolution of a Semi-Ellipsis about its longer Diameter or Axis ; but if a Solid be form'd by the Revolution of a Semi-Ellipsis about its shorter Diameter, 'tis then call'd an *Oblate Spheroid* : And of this Figure is the Earth we inhabit, and perhaps all the Planets are so too, having their Equatorial Diameter longer than their Polar.

PROMONTORY, is an Hill or high Land running out into the Sea, the Extremity of which towards the Sea, is usually call'd a *Cape*, or *Headland*.

PROPORTION,

1. *Magnitudes* are said to have Proportion to each other, which being multiply'd can exceed one another.

2. *Magnitudes* are said to be in the same Ratio, the first to the second, and the third to the fourth, when the Equimultiples of the first and third, compared with the Equimultiples of the second and fourth, according to any Multiplication whatsoever, are either both together greater, equal, or less, than the Equimultiples of the second and fourth, if those be taken that answer each other.

That is, if there be four Magnitudes, and you take any Equimultiples of the first and third and also any Equimultiples of the second and fourth. And if the Multiple of the first be greater than the Multiple of the second, and also the Multiple of the third greater than the Multiple of the fourth : Or, if the Multiple of the first be equal to the Multiple of the second ; and also the Multiple of the third equal

equal to the Multiple of the fourth: Or, lastly, if the Multiple of the first be less than the Multiple of the second; and also that of the third less than that of the fourth; and these Things happen according to every Multiplication whatsoever; then the four Magnitudes are in the same Ratio, the first to the second, as the third to the fourth.

3. Magnitudes that have the same Proportion, are called Proportionals.

Expounders usually lay down here that Definition which *Euclid* has given for Numbers only, in his seventh Book, viz. That

Magnitudes are said to be Proportionals, when the first is the same Equimultiple of the second, as the third is of the fourth, or the same Part, or Parts.

But this Definition appertains only to Numbers and Commensurable Quantities; and so since it is not universal, *Euclid* did well to reject it in his 5th Element, which treats of the Properties of all Proportionals; and to substitute another general one, agreeing to all Kinds of Magnitudes. In the mean Time, Expounders very much endeavour to demonstrate the Definition here laid down by *Euclid*, by the usual received Definition of Proportional Numbers; but this much easier flows from that, than that from this.

1. If there are four Quantities proportional as a, ea, b, eb , then they will be also Proportional.

1. Inversely, $ea : a :: eb : b$.

2. Alternately, $a : b :: ea : eb$.

3. Compoundedly,

$$a + ea : ea :: b + eb : eb.$$

4. Conversely, $a + ea : a :: b + eb : b$.

5. Dividedly,

$$a - ea : \left\{ \begin{matrix} ea \\ a \end{matrix} \right\} :: b - eb : \left\{ \begin{matrix} eb \\ b \end{matrix} \right\}.$$

6. By a *Syllepsis*,

$$a : ea :: a + b : ea + eb.$$

7. By a *Dialepsis*,

$$a : ea : a - b :: ea - eb.$$

2. If in two Rows of Proportionals $a : ea :: b : eb$, and $ea : oa :: eb : ob$. then by ordinate Proportion of Equality, $a : oa :: b : ob$. But if they are disorderly placed, viz. $oa : ea :: ob : eb$. and $ea : a :: eob : ob$: then $oa : a :: eob : eb$. If there are two Rows of Proportionals $a : ea :: b : eb$; $c : oc :: d : od$: then shall $a \times c : ea \times oc :: b \times d : eb \times od$. All these are manifest by comparing the Rectangles of the Means, and Extremes, or by dividing the Consequents by their Antecedents.

PROPORTIONAL SCALES, sometimes also call'd *Logarithmetical*, are only the Artificial Numbers or Logarithms placed on Lines, for the Ease and Advantage of multiplying, dividing, extracting Roots, &c. by the means of Compasses, or by Numbers, as they are call'd by *Mr. Gunter*; but made Single, Double, Triple, or Quadruple; beyond which they seldom go.

PROPORTIONAL *Spiral Lines*. See *Spiral Lines*.

PROSTAPHERESIS, in Astronomy, is the same with the Equation of the Orbit, or simply the Equation; and is the Difference between the true and mean Motion of a Planet. The Angle also made by the Lines of the Planets mean and true Motion, is call'd the *Prostapheresis*.

PROTRACTING-PIN, is a fine Needle fastned in a Piece of Wood, Ivory, &c. used to prick off any Degrees and Minutes from the Protractor. PRO-

P T

PROTRACTOR, is an Instrument used in Surveying: It is commonly made of a well polished thin Piece of Brass, and consisteth of a Semi-Circle divided into Degrees, and a Parallelogram with Scales upon it, and may be of any Bigness desired.

Its Use is chiefly to lay down an Angle of any assigned Quantity of Degrees: Or, an Angle being protracted, to find the Quantity of Degrees it contains readily; which is of great use in plotting, and making of Draughts, &c.

PSEUDOSTELLA, in Astronomy, signifies any Kind of Comet or Phenomenon newly appearing in the Heavens like a Star.

PTOLEMAICK System of the Heavens, was that invented by *Ptolemy*; in which he supposes the Earth immoveable any Way in the Centre of the Universe, round about which the Moon first moves in a Circle; next her *Mercury*, then *Venus*: Above whom moves the *Sun*, then *Mars*; above him *Jupiter*, and last of all *Saturn*, all in the Zodiac from West to East. Above *Saturn* he places the Sphere of the fixed Stars, which he supposes to move slowly also, from East to West, on the Poles of the Ecliptick. While the fixed Stars themselves, and all the Planets, move from East to West on the Poles of the Equator, in the Space of a natural Day or 24 Hours. This vulgar System of Astronomy, (in which I omit to mention the Epicycles and Deferents, &c. with which they endeavour'd to solve the Phenomena which did almost all of

P U

them contradi& this Scheme) was plainly overturned and refuted as soon as ever the use of the Telescope acquainted us with the Phases of *Venus* and *Mercury*; for from thence it was apparent, that their Orbits included the Sun, and therefore by Degrees it came to be quite disused.

PULLEY, is a little Wheel moveable about its Axis, over which goes a Drawing-Rope.

1. In several Cases where the Axis in Peritrochio cannot conveniently be applied, Pulleys must be made use of to raise Weights: A Machine made by combining several of them, lies in a little Compass, and is easily carry'd about, if the Weight be fix'd to the Pulley, so that it may be drawn up along with it: Each End of the Drawing or Running-Rope sustains half the Weight; therefore when one End is fixed, either to a Hook, or any other Way, the moving Force or Power applied to the other End, if it be equal to half the Weight, will keep the Weight in *Æquilibrio*.

2. Several Sheaves may be joined in any Manner, and the Weight be fixed to them; then if one End of the Rope be fixed, and the Rope goes round all those Sheaves, and as many other fixed ones as is necessary, a great Weight may be raised by a small Power: In that Case, the greater the Number of Sheaves fixed in a moveable Pulley, or of moveable Wheels are (for the fixed ones do not change the Action of the Power,) so much may the Power be less, which sustains the Weight; and a Power which is to the Weight as the Number one to twice

P U

twice the Number of the Sheaves will sustain the Weight.

PULSE, by the Mathematical Naturalists, is the Term used for that Stroke with which any Medium is affected by the Motion of Light, Sound, &c.

And Sir *Isaac Newton*, demonstrates, *Lib. 2. Prop. 48. Princip.* that the Velocities of the Pulses, in any elastick fluid Medium, (whose Elasticity is proportionable to its Density,) are in a Ratio, compounded of half the Ratio of the Elastick Force directly, and half the Ratio of the Density inversely. So that in a Medium, whose Elasticity is equal to its Density, all Pulses will be equally swift.

PULSION, is the driving or impelling of any Thing forward.

PUNCHINS, in Architecture, are short Pieces of Timber placed to support some considerable Weight: They commonly stand upright between the Posts, and are shorter and slighter than either the Principal Posts or Prick-Posts. Those that stand on each Side of a Door are call'd *Door-Punchins*.

PUNCTATED HYPERBOLA, is any Hyperbola whose Oval Conjugate is infinitely small, that is, a Point.

PUNCTUM FORMATUM seu GENERATUM, in Conicks, is a Point determined by the Intersection of a Right Line drawn thro' the Vertex of a Cone to a Point in the Plane of the Base, with the Plane that constitutes the Conick Section. See *De la Hire's Latin Conicks*, p. 15, 16.

PUNCTUM EX COMPARATIONE, is either Focus, in an Ellipsis and Hyperbola; and it was so call'd by *Apollonius*, because the Rect-

P Y

angles under the Segment of the Transverse Diameter in the Ellipsis, and under that and the Distance between the Vertex and Focus in the Hyperbola, are equal to $\frac{1}{2}$ Part of what he calls the Figure.

PUNCTUM LINEANS, is that Point of the Generating Circle, which in the Formation of either Simple Cycloids or Epicycloids, produces any Part of a Cycloidal Line.

PURE HYPERBOLA, is one which, by the Impossibility of its Roots, is without any Oval, Node, Spike, or Conjugate Point.

PURLINES, in Architecture, are those Pieces of Timber which lie a-cross the Rafters on the Inside, to keep them from sinking in the Middle of their Length.

PYRAMID, in Geometry, is a solid Figure, whose Base is a Polygon, and whose Sides are plain Triangles, their several Tops meeting together in one Point.

1. A Pyramid is $\frac{1}{3}$ of the Perpendicular Altitude multiply'd by the Base.

2. The Superficial Area of a Pyramid is found by adding the Area of all the Triangles, whereof the Sides of the Pyramid consist, into one Sum.

3. The External Surface of a right Pyramid, that stands on a Regular Polygon-Base, is equal to the Altitude of one of the Triangles which compose it, multiplied by the whole Circumference of the Base of the Pyramid.

The Demonstrations of the three following Problems being short and easy, and not every where

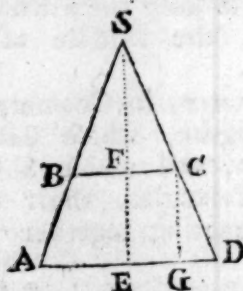
P Y

where to be found; I therefore thought it might not be amiss to insert them here.

1. To find the Solidity of the Frustrum of a square Pyramid.

Let AD be one of the Sides of the Greater Base, which let us call b , and BC the Side of the Lesser Base, which call a ; and let EF be the Height of the Frustrum, which let be h .

Now, compleat the whole Pyramid ASD , and draw the Line CG , parallel to EF . Now, because the Triangles ADS , BCS , are si-



milar, it will be as $b-a$:
 $(2GD) b :: (EF=GC) b$:
 $(AD): \frac{bb}{b-a}$ (ES). And in like
manner, as $b-a$: $(2GD) b ::$
 $(EF=GC) a$: $(BC): \frac{ab}{b-a}$ (FS).
Therefore, the Solidity of the
Pyramid ASD , will be $\frac{b^3}{3b-3a}$.
And the Solidity of the Pyramid
 BSC , will be $\frac{ba^3}{3b-3a}$, and con-
sequently the Solidity of the
Frustrum $ABCD$ of the Pyramid,

P Y

will be $\frac{bb^3-ba^3}{3b-3a}$; and by di-
viding $3b-3a) bb^3-ba^3$ ($\frac{bbb}{3} +$
 $\frac{baa}{3} + \frac{bab}{3}$). This last Expre-
sion will be the Solidity of the
Frustrum; therefore, if the Sum
of the Bases, and the Rectangle
under the Sides AD and BC , are
added together, and multiply'd
by $\frac{1}{3}$ of the Height EF , the Pro-
duct will be the Solidity of
the Frustrum.

COROLLARY.

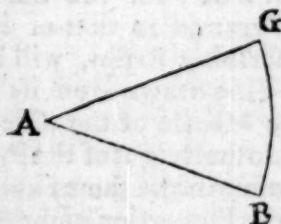
Hence the Solidity of the Frustrum of a Cone, (or any other Kind of Pyramid, may be also found. For it is but adding the two Circular Bases together, and to that Sum a mean Proportional between the said Circular Bases, and then multiplying the whole Sum by $\frac{1}{3}$ of the Height, and that will be the Solidity of the Frustrum of a Cone. For let the Ratio of the Square of the Diameter of a Circle to the Area thereof be as r to s : Then the Solidity of the Frustrum of a Cone circumscribing the Frustrum of the beforemention'd square Pyramid, will be $\frac{b}{3} \times \frac{sbb}{r}$
 $+ \frac{saa}{r} + \frac{sba}{r}$. Whence it is ma-
nifest, that $\frac{sbb}{r}$, and $\frac{saa}{r}$ is the
Sum of the Circular Bases, and
 $\frac{sba}{r}$ a mean Proportional between
the Circular Bases. Therefore
the Corollary is manifest.

2. To find the Curve-Superficies of a right Cone.

If a right Cone ABD lies upon the Plane AC , or touches it in the Right Line AB ; and if the said Cone revolves upon the said Plane about the Point A , until



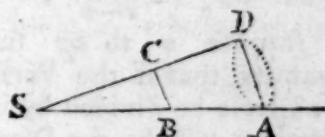
the Point B , in the Periphery of the Base, comes to touch the Plane again. Then, I say, that the whole Superficies of the Cone will have touched the Plane in every Part; and consequently, if the Lines AB , AG , be equal to AB , the slant Height of the Cone, and about the Centre A , be described a Portion of a Circle, whose Length BG is equal to the Periphery of the Circular Base



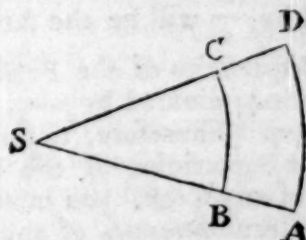
of the Cone, that the Area of the Circular Sector ABG will be equal to the Curve Superficies of the Cone. Therefore, if half the Periphery of the Base of any Right Cone be multiply'd by the slant Height, you will have the Area of the Curve-Surface thereof.

3. To find the Area of the Curve-Surface of the Frustum of a Right Cone.

Let us call the slant Height AB , a ; the Diameter AD of one of the Bases c , and the



Diameter of the other Base BC , b . Also let us call the Periphery of the greater Base p , and of the lesser q . Now, if SB , SA , are equal to SB , SA , and about the



Point S be describ'd 2 Concentrick Portions of Circles, the greater of which is equal to the Periphery of the greater Circular Base DA , then the Area $CDAB$ will be equal to the Area of the Curve Superficies of the Frustum sought. Now to get this Area we must find SA , and

SB , the former will be $\frac{ac}{c-b}$

and the other $\frac{ab}{c-b}$, whence the

Area of the Sector SAD , will be $\frac{p a c}{2c-2b}$ and the Area of the

other

other lesser Sector SCB, will be $\frac{qab}{2c-2b}$. And therefore the Area

of the Figure CDAB, that is the Area of the Superficies of the Frustrum, will be $\frac{pac-qab}{2c-2b}$.

That is, $\frac{a}{2} \times \frac{pc-qb}{c-b}$. Now let us suppose n to be such a Quantity, that if the Periphery of a Circle be divided by it, the Quotient will be the Diameter.

This being suppos'd, $\frac{p}{n} = c$, and

$\frac{q}{n} = b$. Then our last Theo-

rem will be thus, $\frac{pp-qq}{p-q}$ multi-

ply'd by $\frac{a}{2}$ will be the Area of the Superficies of the Frustrum; but $pp-qq$ divided by $p-q$, will be $p+q$. Therefore, to find the Curve-Superficies of the Frustrum of any Cone, you must add the Circumferences of the two Bases together, and that Sum multiply'd by $\frac{1}{2}$ of the slant Height, will be the Area of the Curve-Superficies sought.

Here I cannot omit observing some gross Faults, (unbecoming every one that calls himself a Teacher of the Mathematicks,) which I find in a Book in two Volumes, call'd, *A System of Mathematicks*, printed in the Year 1723. where in Page 85, 86, of Vol. 1. the Author says,

"1. That the Surface of every Prism is equal to a Parallelogram, whose Base is the Perimeter of the Prism, and Height equal to the Prism's Altitude. Wherefore, says he,

"if the Perimeter of any Prism be multiply'd by the Altitude, the Product will be the Superficial Area." But this is only true in such Prisms, all of whose Faces are at Right Angles to the Planes of their Bases: As any one, of but a mean Knowledge in the very Elements of Geometry will easily perceive.

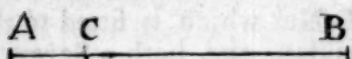
2. He says, "The Surface of every Pyramid is equal to a Triangle, whose Base is equal to the Perimeter of the Prism, (circumscribing it he means) and Height equal to the Height of the Prism; and so the Circumference of the Pyramid multiply'd into its Height, is equal to its superficial Area." From whence he says, it is evident, that the Superficies of a Pyramid is to the Superficies of the Circumscribing Prism, as 1 to 2." But this is enormously false: For there is no standing Proportion between them. And even, if the Pyramid be a right one, it is not true; for the Surface of the Pyramid to that of its Circumscribing Prism, will be as $\frac{1}{2}$ of a Line drawn from its Vertex to the Middle of the Side of the Base, to the Height of the Pyramid. He commits the same Fault in stating the Proportion of the Surface of a Cylinder and Cone inscrib'd in it: For he says, the Surface of the former is double of that of the latter; that is, they are to each other as 2 to 1. Whereas they truly are as the Height of the Cone, to $\frac{1}{2}$ the Side or Slant Height, if it be a right Cone; but if an Oblique, the Proportion has not yet been determin'd by any Body.

Having

P Y

Having happen'd upon a very easy Way of squaring the Parabola, by the Method of Indivisibles, I thought it would not be amiss to insert it here. But first the following Lemma must be demonstrated.

The Sum of all the Rectangles that can be made by cutting the given Line A B into two Segments, as ACXCB, is equal to $\frac{1}{6}$ of the Cube of the said Line.

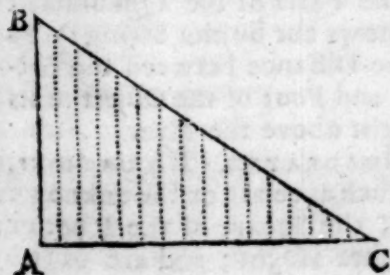


DEMONSTRATION.

Let us call the whole Line a , the Segment Ac , x , then $a - x \times x$ will be the first Rectangle, $a - 2x \times 2x$, the Second, $a - 3x \times 3x$, the Third, and $a - 4x \times 4x$, the Fourth, and so on. That is, the Sum of the Rectangles will stand thus,

$$\begin{aligned} a \times 1x &= 1xx \\ a \times 2x &= 4xx \\ a \times 3x &= 9xx \\ a \times 4x &= 16xx, \text{ \&c.} \end{aligned}$$

From whence you may see that the Sum of all the first Terms will be equal to the Solidity of a Triangular Prism whose Height is a , and the Base the Right-angled Isosceles Triangle CAB , each of whose equal



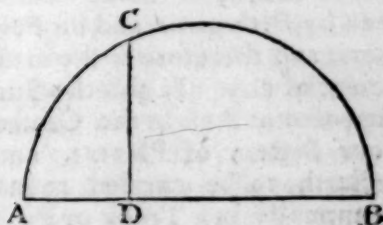
P Y

Sides, is $= a$. Therefore the Sum is $\frac{a^3}{2}$. Again the Sum of all the Second Terms, (because the Coefficients are the Squares of Numbers in Arithmetical Progression,) will be equal to a Square Pyramid, having its Base double to BAC , and the same Altitude a , whence their Sum will be $\frac{a^3}{3}$. And taking $\frac{a^3}{3}$ from $\frac{a^3}{2}$, you will have $\frac{1}{6}aaa$ for the Sum of all the Rectangles, Q, E, D .

COROLLARY. I.

Hence the Sum of the Squares of all the Sines CD drawn in a Circle, is equal to $\frac{1}{6}$ of the Cube of the Diameter. And so the Solid call'd, the *Hoof* or *Ungula*, may be squar'd.

Likewise from hence we may have the Quadrature of the Apollonian Parabola: For because the Rectangle under $AC \times CB$, is



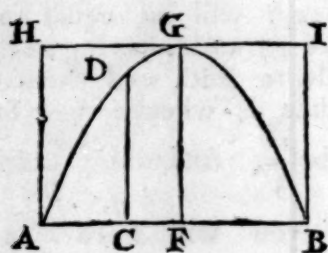
equal to DC multiply'd into some standing Quantity, as m , which is the *Latus Rectum*: Therefore $\frac{1}{6}$ of the Cube of AB , divided by m , will be the Area of the Parabola. Now $m = \frac{aa}{4}$ divided by

X

GF,

P Y

GF, which suppose b , that is, $\frac{a}{4b} = m$. Therefore the Area of the Parabola will be $\frac{a^3}{6}$ divided



by $\frac{aa}{46}$, which will be $\frac{4}{6}ba$, or $\frac{2}{3}$ of the Circumscribing Parallelogram AHIB.

PYRAMIDOID, is what is sometimes called a *Parabolick Spindle*; and is a solid Figure form'd by the Revolution of a Parabola round its Base or greatest Ordinate.

PYTHAGOREAN THEOREM, is the 47th Prop. of the first Book of *Euclid*.

PYTHAGOREAN SYSTEM, is the same with the *Copernican*, but is so called, as being maintained by *Pythagoras* and his Followers, and therefore is the most Ancient of any. In this the Sun is supposed at Rest in the Centre of our System of Planets, and the Earth to be carried round him annually in a Track or Path between *Venus* and *Mars*.

Q

QUADRANGLE, or *Quadrangular Figure* in Geometry, is that which hath four Angles.

Q U

QUADRANT, is an Arch which is the fourth Part of a Circle, containing 90 Degrees. And oftentimes the Space contained between a Quadrantal Arch, and two Radii perpendicular one to another in the Centre of a Circle, is called a *Quadrant*.

QUADRANT of Altitude, is a Part of the Furniture of an Artificial Globe, being a thin Brass-Plate divided into 90 Degrees, and marked upwards with 10, 20, 30, &c. being rivetted to a Brass-Nut which is fitted to the Meridian, and hath a Screw in it, to screw upon any Degree of the Meridian: When it is used, 'tis most commonly screwed to the Zenith. Its Use is for measuring of Altitudes, to find Amplitudes and Azimuths, and describing Almicantrs.

QUADRANT ASTRONOMICAL, See *Astronomical Quadrant*.

QUADRANT TRIANGLE. See *Triangular Quadrant*.

QUADRANTAL TRIANGLE, is a Spherick Triangle, one of whose Sides, (at least,) is a Quadrant, and one Angle Right.

QUADRAT, or LINE of SHADOWS on a Quadrant, are only a Line of natural Tangents to the Arches of the Limb, and are placed there in order to measure Altitudes readily; for it will always be, As the Radius to the Tangent of the Angle of Altitude at the Place of Observation; (that is, to the Parts of the Quadrats or Shadows cut by the String :) So is the Distance between the Station and Foot of the Object to its Height above the Eye.

QUADRATICK EQUATIONS, are such as retain on the unknown Side, the Square of the Root or Number sought; and are of two Sorts.

1. *Sim*

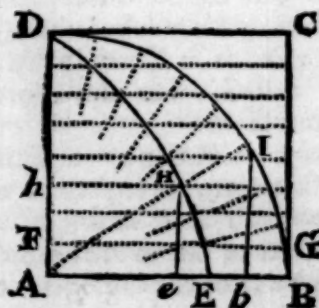
1. *Simple Quadratics*, where the Square of the unknown Root is equal to the absolute Number given, as $aa=36$, $ee=146$, $yy=133225$. And for the Solution of those, there needs only to extract the Square Root out of the known Number, and that is the Value of the Root or Quantity sought: Thus the Value of a in the first Equation is equal to 6, in the second $e=12$ and a little more, it being a surd Root, and in the third Example $y=365$.

2. *Adfected Quadratics*, are such as have between the highest Power of the unknown Number and the absolute Number given, some intermediate Power of the unknown Number, as $aa+2ba=100$.

And this Equation is properly called *Adfected*; because the unknown Root a is multiplied into the Coefficient $2b$.

All Equations of this Rank will be in one of these three Forms, $aa+ad=R$. $aa-ad=R$. $ad-aa=R$.

QUADRATRIX, (in Geometry,) is a Curve-Line thus generated. Let there be a Radius of a Circle, as AD , which imagine to move on the Centre A down



the Circumference of the Quadrant DB , and at the same Time let the Side of the Square CD

move equally downwards, so that the Radius AD , and the Side of the Square CD may come to the Line AB together. Or let the Right Line DA , and the Quadrantal Arch DB , be both divided into a like Number of equal Parts, as in this Case they are each into 8. and to the Divisions of the Quadrant, let as many Radii be drawn from the Centre A , and through the Divisions in AD as many Parallels to CD ; for then if a Curve-Line be drawn neatly connecting the Points of Intersection of these Radii and Parallels, it will be that Line which is call'd the *Quadratrix*, (as DE .)

1. If through any Point, as H in this Quadratrix, you draw a Radius AH , and the two Perpendiculars Hb and He , it will be, As the whole Quadrantal Arch DB , is to the Part IB : So will the whole Right Line DA be to the Part of it cut off bA , or its Equal He .

2. Wherefore any Arch of the Quadrant as IB , or any Angle as IAB , may by this Quadratrix be easily divided into three equal Parts, or any other Number at Pleasure, or according to any given Ratio, by only drawing the Radius AI , and then from the Point of the Quadratrix H , letting fall the Perpendicular He .

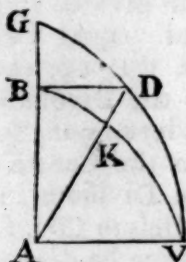
3. The Base of the Quadratrix AE , is a third Proportional to the Radius AD , and the Quadrant BD .

4. If on the Base of the Quadratrix AE , a Quadrantal Arch be described, it will be equal in Length to DA the Side of the Square: And consequently the

Q U

Semi-Circle will be double, and the Periphery Quadruple of *D A*.

5. If *AV* the Base of a Circle inscribed in the Quadratrix, *GV*



be 1, and the Arch of the Curve *VK* be called *x*, then will the Area

$$BDVA = x - \frac{1}{9}x^3 - \frac{1}{225}x^5 - \frac{1}{13230}x^7 - \text{etc.}$$

QUADRATURE of any Figure in the *Mathematicks*, is the finding a Square equal to the Area of it.

QUADRATURES of the Moon, are the Middle Points of her Orbit, between the Points of Conjunction and Opposition: And they are so called, because a Line drawn from the Earth to the Moon, is then at Right Angles, with one drawn from the Earth to the Sun.

QUADRILATERAL FIGURES, are those whose Sides are four Right Lines, and those making four Angles; and they are either a Parallelogram, Trapezium, Rectangle, Square, Rhomboides, or Rhombus.

QUADRIPARTITION, is to divide by Four, or to take the 4th Part of any Number or Quantity.

QUALITY, signifies in the General the Properties or Affections of any Being, whereby it

Q U

affects our Senses so and so, and acquires such and such a Demonstration.

1. *Sensible Qualities*, are such as are the more immediate Objects of our Senses.

3. *Occult Qualities*, were by the Antients named such, of which no rational Solution in their Way, or according to their Principles, could be given.

QUANTITY, signifies whatsoever is capable of any Sort of Estimation or Mensuration, and which being compared with another Thing of the same Nature, may be said to be greater or less, equal or unequal to it.

1. The Quantity of Matter in any Body, is its Measure arising from the joint Consideration of its Magnitude and Density.

2. The Quantity of Motion in any Body, is its Measure arising from the joint Consideration of the Quantity of Matter in, and the Velocity of the Motion in that Body.

QUARTERS in a Clock, or Movement, are little Bells which sound the Quarters, or other Parts of an Hour.

QUARTILE, is an Aspect of the Planets, when they are 3 Sines or 90 Degrees distant from each other, and is marked thus □.

QUAVER, is a Note in Musick so called. See the Words *Notes* and *Time*.

QUEUE A'RONDE, a Term in Fortification, being what we call *Swallow's Tail*; and signifies a Detached or Out-work, whose Sides open towards the Head or Campaign, or draw narrower or closer towards the Gorge. Of this Kind are either single or double Tenailles, and some Horn-works, whose Sides are not parallel

QU

rallel, but are narrow at the Gorge, and open at the Head, like the Figure of a *Swallow's Tail*.

When these Works are cast up before the Front of a Place, they are defective in this Point, that they do not sufficiently cover the Flanks of the opposite Bastions; but then they are very well flanked by the Place, which covers all the Length of their Sides the better.

QUINCUNX, is that Position, or Aspect, that the Planets are said to be in, when they are distant from each other 150 Degrees, or 3 Signs, and is marked thus, *Vc. or Q.*

QUINDECAGON, is a plain Figure of 15 Sides and Angles, which if they are all equal to one another, is called a *Regular Quindecagon*.

The Side of a *Regular Quindecagon*, so described, is equal in Power to the half Difference between the Side of the Equilateral Triangle, and the Side of the Pentagon; and also to the Difference of the Perpendiculars let fall on both Sides, taken together.

QUINQUEANGLED, in Geometry, is a Figure consisting of five Angles.

QUINTILE, an Aspect of the Planets when they are 72 Degrees distant from one another, and is noted thus, *C. or O.*

QUINTUPLE, five-fold or five times as much as another Thing.

QUOTIENT, is that Number in Division which arises by dividing the Dividend by the Divisor: And is called the *Quotient*, because it answers to the Question, how often one Number is contained by another.

QUOIN, the Workman's Term for an Angle or Corner.

RA

R.

RABANET. See *Rabine*.

RABINET, a Sort of Ordnance, whose Diameter at the Bore is $1\frac{1}{2}$ Inches, Weight 300 Pounds, Length 5 Foot, Load $\frac{1}{4}$ of a Pound, Shot something more than an Inch and a quarter Diameter, and $\frac{1}{2}$ a Pound weight.

RADIANT POINT, is the Point from which the *Divergent Rays* proceed.

RADIATION, signifies the Casting forth of Beams, or Rays of Light; and, in Opticks, it is considered as threefold, *viz. Direct, Reflected, and Refracted*. See *Ray*.

RADIUS, in Geometry, is the Semi-Diameter, or half the Diameter of a Circle.

Radius of the Curvature of a Curve, is the Radius of a Circle that has the same Curvature in a given Point of the Curve, that the Curve has in that Point.

RAINBOW, or *Iris*. The *Primary Iris*, is only the Sun's Image, reflected from the Concave Surfaces of an innumerable Quantity of small Spherical Drops of falling Rain, with this necessary Circumstance; that those Rays, which fall on the Objects, parallel to each other, should not after one Reflection, and two Refractions, *viz. at going into the Drop, and coming out again*, be dispersed, or made to diverge, but come back again; also to the Eye, parallel to each other.

RAKED TABLE, a Term in Architecture. See *Table*.

R A

RAMMER, is a Staff with a round Piece of Wood at one End, in order to drive home the powder to the Breech of the great Gun; as also the Shot and the Wad, which keeps the Shot from rolling out: At the other End of these Rammers are usually rolled in a certain Piece of Sheep's-Skin fitted to the Bore of the Piece, in order to clear her after she has been discharged; and this is called *Spunging the Piece*.

RAMPART, in Fortification, is the Mass of Earth, which is raised about the Body of any Place, to cover it from great Shot, and consists of several Bastions and Curtains; having its Parapet, Platform, interior and exterior *Talus* and *Berne*; as also sometimes a Stone-Wall, and then they say it is lined. The Soldiers continually keep Guard here, and Pieces of Artillery are planted for the Defence of the Place.

The Height of the Ramparts must exceed three Fathom, as being sufficient to cover the Houses from the Batteries of the Cannon: Neither ought its Thickness to be above ten or twelve, unless more Earth be taken out of the Ditch, than can be otherways bestowed.

The Ramparts of Half-Moons are the better for being low, that the small Fire of the Defendants may the better reach the Bottom of the Ditch; but yet it must be so high, as to be commanded by the Cover'd-Way.

RANDOM-SHOT, is a Shot made when the Muzzle of a Gun is raised above the Horizontal Line, and is not designed to shoot directly, or point-blank. The utmost Random of any Piece, is

about ten Times as far as the Bullet will go point-blank.

The Distance of the Random is reckoned from the Platform to the Place where the Ball first grazes.

RANGE, a Term in Gunnery, signifying the Line a Shot goes in from the Mouth of the Piece: If the Bullet goes in a Line parallel to the Horizon, that is called the *Right* or *Level Range*; if the Gun be mounted to 45 Degrees, then will the Ball have the highest or utmost Range; and so proportionably all others between 60 Degrees and 45, are called the *Intermediate Ranges*.

1. If two Elevations are taken at equal Distances from 45 Degrees, one above, and the other below it, the Ranges shall be equal.

2. The Greatest Altitude of a perpendicular Projection, is equal to half the Greatest Range.

3. When Projectiles are thrown into the Air, the Greater Range is at the Elevation of 44 Degrees and a half; the Lower Ranges go farther than the upper Correspondent Range, and the greatest Height of the perpendicular Projection is more than half the greatest Range. All these Irregularities are occasioned by the Resistance of the Medium.

RARE BODIES, are such as have more Space, or take up more Room in proportion to their Matter, than other Bodies do.

RAREFACTION of any Natural Body, is when it takes up more Dimensions, or a larger Space than it had before.

RASANT Line of Defence. See *Line of Defence Rasant*.

RASH. See *Ratch*.

RATCH

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RATCH, is a Sort of Wheel of twelve large Fangs that runneth concentric to the Dial-Wheel, and serveth to lift up the Dentes every Hour, and make the Clock strike ; and are by some called *Rash*.

RATCHET, in a Watch, are the small Teeth at the Bottom of the Fusee or Barrel, that stop it in winding up.

RATIO. When two Quantities are compared one with another, in respect of their Greatness or Smallness, that Comparison is called *Ratio*.

RATIONAL HORIZON. See *Horizon*.

RATIONAL QUANTITIES. Any Quantity being proposed, for which we may always put 1, and which *Euclid*, (*Book X.*) calls *Rational*, there may be infinite others, which are commensurable, or incommensurable to it ; and that either simple, or in Power. Now, all such as are commensurable any how to the given Quantity, he calls *Rational Quantities*, and all the others *Irrational*.

RAVELIN, in Fortification, is a small Triangular Work composed only of two Faces, which make a salient Angle, without any Flanks. It is generally raised before the Curtains or Counterscarp, and commonly called a *Half Moon* by the Soldiers.

A Ravelin is like the Point of a Bastion with Flanks cut off. The Reason of its being placed before a Curtain, is to cover the opposite Flanks of the two next Bastions. 'Tis used also to cover a Bridge, or a Gate ; and 'tis always placed without the Moat.

What the Engineers call a *Ravelin*, the Soldiers generally

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call a *Half Moon* ; which see.

RAY of Refraction, or Broken Ray, is a Right Line, whereby the *Ray of Incidence* changeth its Rectitude, or is broken in traversing the second Medium, whether it be thicker or thinner.

RAVS, or BEAMS of the Sun, or RAYS of Light, are either according to the Atomical Hypothesis, those very minute Particles, or Corpuscles of Matter, which continually issuing out of the Sun, do thrust on one another all round in physical short Lines ; and that this is the right Opinion, many Experiments do evince, particularly Sir *Isaac Newton's* about Light and Colours ; or else as the Cartesians assert, they are made by the Action of the Luminary on the contiguous *Æther* and Air, and so are propagated every Way in straight Lines, through the Pores of the Medium.

RAVS CONVERGENT. See *Converging Rays*.

RAVS DIVERGENT. See *Diverging Rays*.

REACH, is the Distance between any two Points of Land, that lie in a Right Line one from another.

RECESSION of the Equinoxes, is the going back of the Equinoctial Points every Year about fifty Seconds.

RECIPROCAL FIGURES, in Geometry, are such as have the Antecedents and Consequents of the Ratio in both Figures.

RECIPROCAL PROPORTION, is when, in four Numbers, the Fourth is lesser than the Second, by so much as the Third is greater than the First, and *vice versa*.

RECLINATION of a Plane, is the Quantity of Degrees which

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any Plane, on which a Dial is supposed to be drawn, lies or falls backwards from the truly Upright or Vertical Plane.

RECLINING, in Dialling. The Plane that leans from you when you stand before it, is said to be a *Reclining Plane*.

RECLINING DECLINING DIALS. See *Declining, Reclining Dials*.

RECTANGLE, in Arithmetick, is the same with *Product*; which see.

RECTANGLES, in Geometry, are Parallelograms, whose Sides are unequal, but Angles right. Their Area is found by multiplying the two unequal Sides one into another, for then the *Product* is the superficial Content or Area.

RECTANGLED TRIANGLE; the same with *Right-angled Triangle*.

RECTANGULAR, or **RIGHT-ANGLED**, is spoken of a plain Figure in Geometry, when one or more of its Angles are right: Of Solids, 'tis spoken in respect of their Situation; for, if their Axis be perpendicular to the Plane of the Horizon, they are therefore Rectangular, or Right Cones, Cylinder, &c.

RECTANGULAR SECTION of a CONE; by this the antient Geometers always meant a Parabola, which Conick Section, before *Apollonius*, was only considered in a Cone, whose Section by the Axis would be a Triangle, right-angled at the Vertex. And hence it was, that *Archimedes* entituled his Book of the *Quadrature of the Parabola*, (as 'tis now called) by the Name of *Rectanguli Coni Sectio*.

RECTIFY, is a Word used in the Description and Use of the Globe, or Sphere. For the first

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Thing to be done before any Problems can be wrought on the Globe, is to rectify it; that is, to bring the Sun's Place in the Ecliptick on the Globe, to the graduated Side of the brass Meridian, to elevate the Pole above the Horizon, as much as is the Latitude of the Place, and to fit the Hour-Index exactly to Twelve at Noon, screwing also the Quadrant of Altitude, (if there be Occasion) to the *Zenith*.

All this is comprehended under the Word *Rectify the Globe*: And when this is done, the Cœlestial Globe represents the true Posture of the Heavens, for the Noon of that Day it is rectified for.

RECTIFIER, in Navigation, is an Instrument consisting of two Parts, which are two Circles, either laid upon, or let into the other, and so fasten'd together in their Centres, that they represent two Compasses, one fixed, the other moveable; each of them divided into the 32 Points of the Compass, and 360 Degrees, and number'd both Ways, both from the North and the South, ending at the East and West, in 90 Degrees.

The Fixed Compass represents the Horizon, in which the North, and all the other Points of the Compass are fixed and immoveable.

The Moveable Compass represents the Mariner's Compass, in which the North, and all the other Points are liable to Variation.

In the Centre of the Moveable Compass is fasten'd a Silk Thread, long enough to reach the Outside of the Fixed Compass; but, if the Instrument be made of Wood, there is an Index instead

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instead of the Thread. Its Use is to find the Variation of the Compass, to rectify the Course at Sea; having the Amplitude or Azimuth given.

RECTIFYING of Curves, in Mathematicks, is to find a Straight Line, equal to a curved one; or a Plane equal to a curved Surface.

RECTILINEAL, or RIGHT-LINED, in Geometry, is spoken of such Figures as have their Extremities all Right-Lines.

REDENT, in Fortification, is a Work made in form of the Teeth of a Star, with saliant and re-entring Angles, to the end that one Part may defend another. These Sort of Works are usually erected on that Side of a Place which looks towards a Marsh, or River.

REDOUT, in Fortification, is a small Sort of a square Figure, having no Defence but in the Front; its Use being to maintain the Lines of Circumvallation, Contravallation, and Approach.

In marshy Grounds, these Redoubts are often made of Mason's Work, for the Security of the Neighbourhood. Their Face consists of from ten to fifteen Fathom, the Ditch round about being from eight to nine Foot broad and deep, and their Parapets having the same Thickness.

REDUCTION, in Astronomy, is the Difference between the Argument of Inclination, and the Eccentric Longitude; that is to say, the Difference of the two Arches of the Orbit, and the Ecliptick, intercepted between the Node and the Circle of Inclination.

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REDUCTION of Equations, in Algebra, is the Clearing of them from all superfluous Quantities, and the Separating of the known Quantities from the unknown, to the end that at length every respective Equation may remain in the fewest and simplest Terms; and so disposed, that the known Quantities may possess one Part thereof, and the unknown the other.

RE-ENTRING ANGLE, a Term in Fortification. See *Angle*.

REFLECTION, in general, is the Regress or Return that happens to a moving Body, because of the meeting of another Body, which it cannot penetrate. Thus the material Rays of Light are reflected variously from such Bodies as they cannot pass through.

REFLECTION, in Metaphysics, Mr. *Lock* defines to be, that Notice which the Mind takes of its own Operations, and the Manner of them; by reason whereof there comes to be Ideas of those Operations in the Understanding.

REFLECTION of the Rays of Light. Sir *Isaac Newton* finding, by Experiment, that Light was an heterogeneous Body, consisting of a Mixture of differently refrangible Rays; and consequently concluding no further Improvement could well be made in Optical Instruments in the Dioptrick Way, he took Reflections into Consideration, and tells us, that by their Help, Optick Instruments might be brought to any Degree of Perfection; if we could but find a Reflecting Substance, which would polish as finely as Glass, reflect as much Light as Glass transmits, and

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and be formed into a Parabolical Figure

An Experiment of which, he made in the Kind of a Catoptrick Telescope, and by which, tho' not above two Foot long, he could (he saith) discern the *Jovial* Satellites, and the Phases of *Venus*, *Philos. Trans.* N^o 18.

REFLECTED RAY, or Ray of Reflection, is that whereby the Reflection is made upon the Surface of a Reflecting Body.

REFLECTING, or Reflexive Dials, are made by a little Piece of Looking-glass-Plate, duly placed, which reflects the Sun's Rays to the Top of a Ceiling, &c. where the Dial is drawn. This Glass shou'd be as thin as can well be ground.

REFLECTING TELESCOPES. See *Telescopes*.

REFLECTION of the Moon, is (according to *Bullialdus*,) her 3^d Inequality of Motion. This *Tycho* calls by the Name of her Variation. Which see.

REFLUX of the Sea, is the Ebbing of the Water off from the Shore; as its coming on upon it, or Tide of Flood, is called the Flux of the Sea. See *Tide*.

REFRACTED ANGLE, in Opticks, is the Angle contained between the Refracted Ray and the Perpendicular.

REFRACTION, in General, is the Incurvation or Change of Determination in the Body moved, which happens to it whilst it enters or penetrates any Medium.

In Dioptricks, it is the Variation of a Ray of Light, from that Right Line which it would have passed on in, had not the Density of the Medium turned it aside.

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REFRACTION ASTRONOMICAL, is that which the Atmosphere produceth, whereby a Star appears more elevated above the Horizon than really it is.

REFRACTION HORIZONTAL, is that which causeth the Sun or Moon to appear on the Edge of the Horizon, when they are as yet somewhat below it.

REFRACTION from the Perpendicular, is when a Ray falling, inclined from a thicker Medium into a thinner, in breaking departs further from that Perpendicular. And

REFRACTION to the Perpendicular, is when it falls from a thinner into a thicker, and so comes nearer the Perpendicular.

REFRANGIBLE, is whatever is capable of being refracted.

REGEL, or RIGEL, a fixed Star of the first Magnitude in Orion's Left-foot, its Longitude is 72 Degrees, 19 Minutes, Latitude 30^o. 10'.

REGION, is taken for our Hemisphere, or the Space within the four Cardinal Points of the Heavens, or of the Air, &c.

In Geography, it signifies a large Extent of Land inhabited by many People of the same Nation, and inclosed within certain Limits or Bounds.

REGION ÆTHEREAL, in Cosmography, is the vast Extent of the Universe; wherein are comprized all the Heavens and Celestial Bodies.

REGION ELEMENTARY, according to the *Aristotelians*, is a Sphere terminated by the Concavity of the Moon's Orb, comprehending the Earth's Atmosphere.

REGULAR BODY, is a Solid whose Surface is composed of Regular

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Regular and Equal Figures; whose Solid Angles are all equal. Such as the Tetrahedron, Hexahedron, Octohedron, Dodecahedron, and Icosahedron. There can be no more Regular Bodies besides these.

REGULAR CURVES, are such Curves as the Perimeters of the Conick Sections, which are always curved after the same regular Geometrical Manner.

But irregular Curves, are such as have a Point of Inflexion, and which being continued, do turn themselves a contrary Way, as the Conchoid, and the Solid Parabola which hath a Square for its Parameter.

REGULAR FIGURES, in Geometry, are such whose Sides, and consequently their Angles, are all equal to one another. Whence all regular Multilateral Planes are called *Regular Polygons*.

The Area of such Figures is speedily found by multiplying a Perpendicular let fall from the Centre of the inscribed Circle to any Side by half that Side; and then that Product by the Number of the Sides of the Polygon.

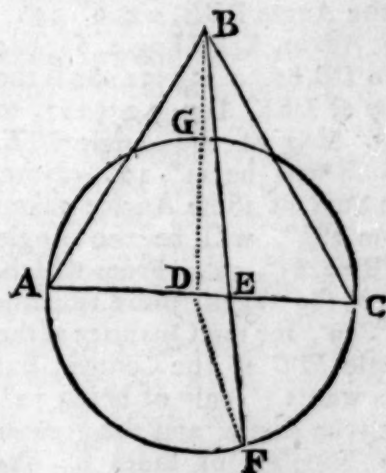
REGULAR FORTIFICATION. See *Fortification*.

REGULAR POLYGON. The Truth of the general Method of *Sturmius's* and *Rhenaldinus's* Method of inscribing any Regular Polygon in a Circle may be trigonometrically examined thus: Suppose *ACG* a Circle, *D* the Centre, *AC* the Diameter, *ABC* the Equilateral Triangle described upon the Diameter, *E* the second Point of Division of the Diameter divided into any Number of equal Parts, *DB* perpendicular to *AC*, and the Points *D, E*, joined.

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1. Now, because the Semi-Diameter *DC*, and the whole Diameter *BC* are given; *BD* may be had, which is equal to the square Root of the Diameter $\overline{AC^2} (= \overline{BC^2}) - DC^2$.

2. Again, because the Number of equal Parts, the Diameter is divided into, for any given Polygon is also given; the Line *CE*, which is equal to two of



those Parts will be given, and consequently the Part *DE* will be had. Then in the Right-Angled Triangle *BDE*, there are given the Sides *BD*, and *DE*, to find the Angle *DBE*, in saying, As *DB* is to *DE*: So is the Radius to the Tangent of *DBL*. Moreover, in the Triangle *DBE*, because the Sides *BD*, and *DE*, and the Angle *DBE*, being now found, are given, the Angle *BDE* may be found; in saying, As *DE* is to *DB*: So is the Sine of the Angle *DBE* to the Sine of the Angle *BDE*, which being found, add it to the Angle *DBE*, and subtract the same from 180 Degrees; the Remainder is the Angle *BDF*; then subtracting the Angle *BDE*, which is a Right

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Angle, from the Angle *BDE*, and there remains the Angle at the Centre *CDE*. For Example, to examine this for a Pentagon, let us suppose the Diameter *AC*, or *CB*, to be 1000, then the Log. *BD*=2.937532. Again, *CE*=400, and consequently *DE*=100. Now say, As *DB*, Log. 2.937532 is to *DE*, Log. 2.000000: So is the Radius 10.000000 to the Logar. Tangent of the Angle *DBE*, viz. $6^{\circ}.35'$.

3. Again, As *DE*, Log. 2.699404 is to *DB*, Log. 2.237532: So is the Sine of *DBE*, Log. 9.059267, to Log. Sine of the Angle *DFE*, which will be $11^{\circ}.26'$. Now, the Sum of these Angles taken from 180° , will be the Angle *FDB*,= $161^{\circ}.59'$. From which, if 90° be taken, there remains $71^{\circ}.59'$, for the Quantity of the Angle *FDC* at the Centre; but this wants 1' only of being 72° , the true Angle; and the greater the Number of Sides is, the greater will the Error be; so that if the Number be 20, the Error will be half a Degree, and more.

REGULATOR, is a small Spring belonging to the Ballance in the Pocket-Watches.

RELAIS, a French Term in Fortification; the same with *Bevme*.

RELATION INHARMONICAL, a Term in Musical Composition, signifying a harsh Reflection of Flat against Sharp, in a cross Form, viz. when some harsh and displeasing Discord is produced, in comparing the present Note of another Part.

RELATIVE GRAVITY, the same with *Specifick*. Which see.

RESIDUAL FIGURE, in Geometry, signifies the remaining

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Figure after Subtraction of a lesser from a greater.

RESIDUAL ROOT, in Mathematicks, is one composed of two Parts or Members, only connected together with the Sign—: Thus $a-b$, or $5-3$, is a Residual Root; and is so called, because its true Value is no more than its Residue or Difference between the Parts a and b .

RESISTANCE of the Medium, is the Opposition against, or Hindrance of the Motion of any Body moving in a Fluid, as in the Air, the Water, the Æther, &c. and this, together with the Gravity of Bodies, is the Cause of Cessation of the Motion of Projectiles, &c. This Resistance, in Mediums, which are very dense and rigorous, so that Bodies can there move but very slowly, is nearly as the Velocity of the moving Body: But in a Medium free from all such Rigour, as the Squares of the Velocities, *Newt. Princip. p. 245*.

1. If an Isosceles Triangle be moved in a Fluid according to the Direction of a Line which is normal to its Base; first with the Vertex foremost, and then with its Base, the Resistances will be as the Legs.

2. The Resistance of a Square moved according to the Direction of its Side, and of its Diagonal, is as the Diagonal to the Side.

3. The Resistance of a Circular Segment, (less than a Semi-circle,) carried in a Direction perpendicular to its Basis, when it goes with the Base foremost, and when with its Vertex foremost, (the same Direction and Celerity continuing, which is all along supposed,) is as the Square of the Diameter, to the same

same less $\frac{1}{3}$ of the Square of the Base of the Segment.

4. Hence the Resistance of a Semi-Circle, when its Base, and when its Vertex goes foremost, are to one another in a Sesquialateral Ratio.

5. A Parabola moving in the Direction of its Axis, with its Base, and then its Vertex foremost, hath its Resistance, as the Tangent to an Arch of a Circle, whose Diameter is equal to half the Base of the Parabola.

6. The Resistance of an Hyperbola, or Semi-Ellipsis when the Base and when the Vertex goes foremost, may be thus computed: Let it be, as the Sum (Difference,) of the Transverse Axis, and Latus Rectum, is to the Transverse Axis: : So is the Square of the *Latus Rectum*, to the Square of the Diameter of a certain Circle, in which Circle apply a Tangent equal to half the Base of the Hyperbola or Ellipsis.

7. Then say again, As the Sum and Difference of the Axis, and again, as the Sum and Difference of the Axis and Parameter, is to the Parameter: So is the aforesaid Tangent to another Right Line: And further, as the Sum (or Difference,) of the Axis: : and Parameter, is to the Axis, :: So is the Circular Arch corresponding to the aforesaid Tangent, to another Arch. This done, the Resistances will be as the Tangent to the Sum (or Difference,) of the Right Line thus found, in that Arch last mentioned.

8. In General, the Resistances of any Figure whatsoever going now with its Base foremost, and then with its Vertex, are as

the Figures of the Base is to the Sum of all the Cubes of the Elementa of the Base divided by the Squares of the Elementa of the Curve-Line.

RESOLVEND, a Term in the Extraction of the Square and Cube-Roots, &c. signifying that Number which arises from augmenting the Remainder after Subtraction, by drawing down the next Square, Cube, &c. and writing it after the said Remainder.

RESOLUTION, in Mathematicks, is a Method of Invention, whereby the Truth or Falshood of a Proposition, or its Possibility or Impossibility is discovered, in an Order contrary to that of Synthesis or Composition: For in this Analytical Method, the Proposition is proposed as already known, granted, or done; and then the Consequences thence deducible are examined, till at last you come to some known Truth or Falshood, or Impossibility, whereof that which was proposed is a necessary Consequence, and from thence justly conclude the Truth or Impossibility of the Proposition; which if true, may then be demonstrated in a Synthetical Method. This Method of Resolution consists more in the Judgment, Penetration, and Readiness of the Enquirer or Artist, than in any particular Rules; tho' those of Algebra are of necessary Use, and a good Treasure of Geometry in his Head will be of great Advantage to him in all manner of Investigations.

R E S T, (in Musick.) See *Pause*.

RESTITUTION, the returning of Elastick Bodies forcibly bent
to

to their natural State, is called the *Motion of Restitution*.

RETIRED FLANK See *Flank*.

RETRENCHMENT, in Fortification, is a Ditch bordered with its Parapet, and secured with Gabions or Bavins laden with Earth. It is sometimes taken for a Simple Retireade in Part of the Rampart, when the Enemy is so far advanced, that he is no longer to be resisted, or beaten from the Post.

RETROCESSION of the Equinoxes, is the annual going backward of the Equinoctial Points about 50 Seconds. See *Equinoxes*.

RETROGRADE, in Astronomy, is usually appropriate to the Planets, when by their proper Motion in the Zodiack, they move backward or contrary to the Succession of the Signs: As from the Second Degree of *Aries* to the First, &c.

But this Retrogradation is only apparent, and occasion'd by the Observer's Eye being placed on the Earth: For to an Eye at the Sun, the Planet will appear always direct, and never either Stationary or Retrograde.

REVERSED TALON. See *Talon*.

REVERSION of Series in Algebra, is a Method to find a Number from its Logarithm, being given; or the Sine from its Arch: The Ordinate of an Ellipsis, from an Area given to be cut off from any Point in the Axis.

REVOLUTION: In Geometry, the Motion of any Figure round a Fix'd Line, (which is called therefore its *Axis*;) is called the *Revolution of that Figure*; and the Figure so moving is said to re-

volve. Thus a Right-angled Triangle revolving round one of its Legs, as an Axis, generates by that Revolution a Cone. And to Instance in a Case very wonderful; the Body called by *TORRICELLIUS Hyperbolicum Acutum*, tho' it self, (as he demonstrates,) be finite, is yet formed by the Revolution of an infinite Area.

RHOMBE SOLID, is two equal and right Cones joined together at their Bases.

RHOMBOIDES, a Figure in Geometry. See *Quadrilateral Figures*.

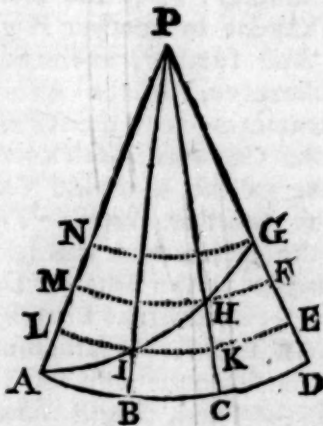
RHOMBUS. See *Quadrilateral Figures*.

RHOMBS. See *Rhumbs*.

The following Propositions being of great Use in the Theory of Navigation, and not to be found every where, I thought it would not be amiss to insert them with their Demonstrations here.

PROP. I.

If the Meridians PA, PB, PC, PD, &c. be at a small Distance from each other, then the Rhumb-Line AIHG is divided into equal



Parts AI, IH, GH, by Parallels, LE, MF, NG, &c. at the equal Distances,

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Distances, BI, HK, GF, from each other.

This is plain, because the Angles B, H, F, being Right Ones, and $PAG = PIG = PHG$, and the Arches AB, BC, CD, being very small, the Triangles AIB, IHK, HGF, may be taken for Right-lin'd Ones.

PROP. II.

The Length of the Rhumb-Line AG, is to the Difference of Latitude GD, in the same Measure as the Radius is to the Cosine of the Course or Angle PAG.

For in the Triangles AIB, IHK, and GHE, as the Radius is to the Sine of the Angles BAI, KIH, FGH, that is to the Cosine of the Course PAG, or PIG, or PLG, PHG, so are the Parts of the Rhumb-Line AI, IH, GH, to the Parts IB, KH, GF, of the Difference of Latitude. Therefore $AI + IH + GH$, that is the Rhumb-Line AG, is to $IB + KH + GF$. That is the Difference of Latitude DG, as the Radius is to the Cosine of the Course.

PROP. III.

The Length of the Rhumb-Line AG is to the Sum of the Bases of the small Right-lin'd Triangles, viz. to $AB + IK + HF$ as the Radius to the Sine of the Angle GAP, or Course.

From the Demonstration of the last Theorem, it is manifest, that the Radius is to the Sine of the Course, as AI to AB, IH to IK, or GH to HF: (That is, since IAB is the Complement of the Course GAP to a Right Angle PAD, and because B is a Right Angle, and also AIB the Complement of BAI to a Right An-

R H

gle, and therefore AIB is equal to the Course PAG.) So is $AI + IH + GH$, that is, AG, to $AB + IK + HF$,

PROP. IV.

The Difference of Latitude DG is to the Sum of $AB + IK + HF$, &c. as the Radius is to the Tangent of the Course PAG, or AIB.

From the Demonstration of the second Theorem, it is manifest, that the Radius is to the Tangent of the Course AIB, as IB to AB, HK to KI, GF to FH. Therefore also, as the Radius is to the Tangent of the Course, so is $IB + HK + GF$, that is the Difference of Latitude DG to $AB + IK + HF$.

PROP. V.

The Sum of $AB + IK + HF$ is a mean Proportion between the Aggregate of the Distance AG and the Difference of Latitude GD, and their Sum.

For $AI^2 - IB^2 = AB^2$, and so $AI + IB : AB :: AB : AI - IB$. Wherefore since after the same Manner it is proved that $IH + HK : IK :: IK : IH - HK$, and $GH + GF : HF :: HF : GH - GF$; therefore shall $AI + IH + HG + IB + HK + GF$ be to $AB + IK + HF$ as $AB + IK + HF$ to $AI + IH + HG - IB - HK - GF$: That is, $AG + GD : AB + IK + HF :: AB + IK + HF : AG - GD$.

From hence it follows, even in Plain Sailing, that of these three Things, viz. the Difference of Latitude, Course, and Distance, any two being given, the other will be had by one Operation of the

the Golden Rule, to a Geometrical Exactness: But the Departure which is represented by the Line *AD*, will not be found by the Common Canon in Plain or Mercator's Sailing.

RIDEAU, in Fortification, is a Ditch, the Earth whereof is raised on its Side, or it is a small Elevation of Earth, extending itself in Length on a Plain, which serves to cover a Post; being also very convenient for those that would besiege a Place at a near Distance; and to secure the Workmen in their Approaches to the Fort of a Fortress.

RIGHT-ANGLED, a Figure is said to be Right-angled, when its Sides are at Right-angles, or stand perpendicularly one upon another: And this is sometimes in all Angles of the Figures, as in Squares and Rectangles: Sometimes only in Part, as in Right-angled Triangles.

RIGHT-ANGLED TRIANGLE.
See *Triangle*.

1. In the following two Progressions, *viz.*

$$1\frac{1}{3}, 2\frac{2}{5}, 3\frac{3}{7}, 4\frac{4}{9}, 5\frac{5}{11}, 6\frac{6}{13}, \&c.$$

$$1\frac{7}{8}, 2\frac{11}{12}, 3\frac{15}{16}, 4\frac{19}{20}, 5\frac{23}{24}, 6\frac{27}{28}, \&c.$$

If the Denominator of the Fraction be taken for the Base, and the Integer multiply'd by the Denominator *Plus* the Numerator for the Perpendicular of any Right-angled Triangle, the Hypothenufe will be a Rational Number.

2. And after the following Manner may an infinite Number of such Series of mixed Numbers, or improper Fractions be found, *viz.* having taken two Terms of any Ratio, in order to

find the Numerator, multiply one of the Terms by the other, and observe whether the Product be Even or Odd; if it be Odd, it will be the Numerator itself; but if it be Even, it will be the Double of the Product: But to get the Denominator, add the said Terms of the Ratio together, and multiply the Sum, if it be Odd by the Difference of the Terms, and that Product will be the Denominator; but if that Sum be Even, half of the Sum will be the Denominator.

3. Now, to obtain a second Numerator, multiply the Difference of the Terms by 2; if it be Even, or by 4, if Odd; and if the Product be multiply'd by the greater Term, this last Product added to the Numerator first found, and you will have a second Numerator.

4. *Lastly*, To have a second Denominator, add the Square of the Difference of the Terms; if it be Even, or the Double of it, if Odd, to the Denominator first found, and that will be a second Denominator.

5. For Example, if the Terms of the Ratio be 1 and 2, these multiply'd make 2, and so 4 shall be the first Numerator. Again, since 1 and 2 added is 3, an odd Number; therefore, 3 multiply'd by 1, the Difference of the Terms is 3, the Denominator. Whence the first Term of the Series will be $\frac{4}{3}$ or $1\frac{1}{3}$. A-

gain, because 1 the Difference of the Terms is Odd; if it be multiply'd by 4, and this Product 4 by 2, the greater Term; 12 the Sum of this Product, and the first Numerator shall be the second Numerator.

6. *Lastly*,

6. *Lastly*, Because 1, the Square of the Difference of the Terms, is odd; therefore, if the Double of it 2, be added to the Denominator 3 before found, the Sum 5 shall be the second Denominator, where $\frac{4}{3}$ and $\frac{12}{5}$ each of them, express two Sides of a Right-angled Triangle, whose Hypotheneuse is rational; and if the Terms of the Ratio, viz. 2 to 3, 3 to 4, 4 to 5, &c. be used; after this Way you will get the Terms of the first Series above.

RIGHT ANGLE. See *Angles*.

RIGHT ASCENSION, of the Sun or Star, is that Degree of the Equinoctial, accounted from the Beginning of *Aries*, which riseth with it in a right Sphere.

Or, 'tis that Degree and Minute of the Equinoctial, (counted as before,) which cometh to the Meridian, with the Sun or Stars, or with any Point of the Heavens. The Reason of which referring it to the Meridian, is because that is always at Right-angles to the Equinoctial; when the Horizon only is in a right or direct Sphere.

RIGHT CIRCLE, in the Stereographical Projection of the Sphere, is a Circle that is at Right Angles, to the Plane of Projection, or that which passes thro' the Eye.

RIGHT LINE, is the nearest Distance between any two Points. See *Line*.

RIGHT SAILING, is when a Voyage is performed on some one of the four Cardinal Points.

RIGHT SINE, the same with *Sine*; which see.

RIGHT, or DIRECT SPHERE, is that which has the Poles of the World in its Horizon, and the Equator in the Zenith: The Consequence of living under such a Position, (as those who live directly under the Line are in,) is that they have no Latitude, nor Elevation of the Pole. They can see nearly both Poles of the World; all the Stars do rise, culminate, and set with them; and the Sun always rises and descends at Right-Angles to their Horizon, and makes their Days and Nights equal; because the Horizon bisects the Circle of this Diurnal Revolution.

RIM, in a Watch or Clock, is the Circular Part of the Ballance thereof.

RING-DIAL. See *Universal Equinoctial Dial*.

RING of Saturn, is an Opacous Solid, Circular Arch or Plane, like the Horizon of a Globe of Matter entirely encompassing round the Planet, and no where touching it; its Plane is at this Time nearly parallel to the Plane of our Earth's Equator; the Diameter of this Ring is $2\frac{1}{4}$ of Saturn's Diameters, and the Distance of the Ring from the Planet, is about the Breadth of the Ring itself. *Galileus* first discovered the Figure of Saturn not to be round; but, that the Inequality was thus in the Form of a Ring, Mr. *Hugens* first found out, and published in his *Systema Saturniana*, 1659. 'Tis this Ring, and its various Positions in respect of the Sun, (whose Light it reflects like the Body of Saturn itself) and of the Eye of the

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Spectator,

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Spectator, which occasions all the various Appearances of *Saturn* with his *Anse*, (as they call them) or with none; with broad or narrow ones, &c.

RISING of the Sun or Star, is their appearing above the Horizon.

ROD, a Measure of Length containing by Statute just sixteen Feet and a half *English*: See *Pole*. This must carefully be distinguished from *Rood*, which is a square Measure containing the fourth Part of an Acre.

ROMAN ORDER, in Architecture, is the same with the *Composite*. 'Twas invented by the *Romans*, in the Time of *Augustus*, and set above all the others, to shew that the *Romans* were Lords over other Nations: 'Tis made up of the *Ionick*, and *Corinthian* Orders, and is more ornamental than either.

RONDEL, in Fortification, is a round Tower, sometimes erected at the Foot of the Bastions.

ROOD, a square Measure, containing just a Quarter of an Acre of Land: Some confound this Measure with a Rod, which is the Length of sixteen Foot and a half; and others with a Yard-Land, or the *Quartona Terra*, but both very erroneously.

ROOT. Whatever Quantity being multiply'd into itself produces a Square, and that Square again being multiply'd by that first Quantity produces a Cube, &c. is called a *Root*, and is either the *Square*, *Cube*, or *Biquadrata Root*, &c. according to the Multiplication: See *Square*, *Cube*, &c. Also the unknown Quantity in an *Algebraick* Equation is often called the *Root*.

ROTA ARISTOTELICA, is the

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Consideration of a Wheel moving along a Plane, till it hath made one entire Revolution: For then will its Centre have described a Line equal to that of the Circumference of the Wheel, and so will all lesser Concentrical Circles.

ROYAL FORT. See *Fort*.

ROYAL PARAPET, or PARAPET of the Rampart, in Fortification, is a Bank about three Fathoms broad, and six Foot high, placed upon the Brink of the Rampart, towards the Country, to cover those who defend the Rampart.

RULE of Three, or the Rule of Proportion, or, as it is called from its excellent Use, the *Golden Rule*, is that which teaches to find a fourth Number, which shall have the same Proportion to one of the three Numbers given, as the others have to one another.

This *Rule of Three* is, 1. *Direct*. 2. *Indirect*. 3. *Double-Rule Direct*. 4. *Double-Rule Indirect*.

1. *Rule of Three Direct* finds a fourth Number in such Proportion to the third, as the second is to the first, or as the first is to the second, so is the third to the fourth.

2. *Rule of Three Indirect, or Backward Rule*, is known by being contrary to the *Direct*; for whereas the former required, that more shall have more, and less less; as if 4 Yards cost 2 s. 8 Yards will cost more than 2. because it is double to 4 Yards; and so must the Answer be double to 2 s. that is, 4 s.

3. *The Double Rule of Three*, both *Direct* and *Indirect*, may be comprised in one Rule, with two Operations, only observing, That the given Terms are al-

ways five, whereof three are Conditional and Antecedent, or Suppositions; the other two demand the Question, and are Consequents answering some of the former Antecedents; insomuch, that with the Answer there will be as many Consequents as Antecedents, which must match one another in the same Denomination exactly.

RUMB, or COURSE of a Ship, is the Angle which she makes in her Sailing with the Meridian of the Place, where she is.

Complement of the Rumb, is the Angle made with any Parallel to the Equator by the Line of the Ship's Run.

RUMB, in Navigation, is one Point of the Compass, or 11 Degrees and a quarter, viz. the 32d Part of the Circumference of the Horizon, or Compass-Card, which is the Representative of the Horizon.

RUMB-LINE, is a Line described by the Ship's Motion on the Surface of the Sea, steered by the Compass, making the same, or equal Angles with every Meridian.

These Rumbs are Helispherical or Spiral Lines, proceeding from the Point where we stand, winding about the Globe of the Earth, till they come to the Pole, where at last they lose themselves.

But in the Plane, and Mercator's Charts, they are represented by straight Lines. Their Use is to shew the Bearing of any Places one from another; that is, upon what Point of the Compass any Shore or Land lies from another.

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SAC CER. See *Saker*.

SACKS of Earth, used in Fortification, are made of coarse Cloth, the largest of them being about a Cubick-Foot wide, and the lesser somewhat more than half a Foot. They are serviceable upon several Occasions, more especially for making Retrenchments in haste, to place on Parapets, or the Head of the Breaches, &c. or to repair them when beaten down. They are of good Use also when the Ground is rocky, and affords not Earth to carry on Approaches, because they can be easily brought on, and carry'd off: The same Bags, on occasion, are used to carry Powder in; of which they hold about fifty Pounds a-piece.

SACER. See *Saker*.

SAGITTA, a Constellation in the Northern Hemisphere, consisting of eight Stars.

SAGITTA, in Mathematicks, is the same as the Versed Sine of any Arch, and is so called by some Writers, because 'tis like a Dart or Arrow standing on the Cord of the Arch. See *Versed Sine*.

SAGITTARIUS, is the Ninth, in the Order of the twelve Signs of the *Zodiack*.

SAILING. See *Plain*, and *Mercator's Sailing*.

SAKER, a Sort of Cannon, and is either Extraordinary, or least Size.

SAKER EXTRAORDINARY, is four Inches Diameter at the
Y 2 Bore,

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Bore, 1800 Pounds weight, 10 Foot long, its Load five Pounds, Shot three Inches and a quarter Diameter, and something more than seven Pounds and a quarter weight; its Level-Range is 163 Paces.

SAKER of the **LEAST** SIZE, is three Inches and three quarters Bore, nine Foot long, 1500 Pounds weight, eight Foot long, its Load near three Pounds and a half, Shot four Pounds and three quarters weight, and three Inches one quarter Diameter.

SAPPE, in Fortification, formerly signified the Undermining, or Deep Digging with Pick-ax and Shovel at the Foot of a Work to overthrow it without Gunpowder: Now, it is used to signify a Deep Trench carry'd far into the Ground, and descending by Steps from Top to Bottom; so that it covers the Men sideways; and to save them from Danger on the Top, they use to lay a-cross it Madriers, that is, thick Planks, or Clugs, that is, Branches of Trees close bound together, and then they throw

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Earth over all to secure them from Fire.

When a Cover'd-Way is well defended by Musqueteers, the Besiegers must make their Way down into it by Sapping.

SARRASIN, in Fortification, is a kind of Portcullice, otherwise called a *Herse*, which is hung with a Cord over the Gate of a Town or Fortrefs, and let fall in case of a Surprise.

SATELLITES, by Astronomers, are taken for those Planets which are continually, as it were, waiting upon, or revolving about other Planets; as the Moon may be called the *Satellite of the Earth*; and the rest of the Planets, *Satellites of the Sun*; but the Word is chiefly used for the new discovered small Planets, which make their Revolution about *Saturn* and *Jupiter*.

SATELLITES of *Jupiter*, are four small Moons or Planets moving round about the Body of *Jupiter*, as the Moon doth round our Earth: They were first discovered by *Galileus*, by the Help of the Telescope.

The Distances of these Satellites, from the Body of Jupiter, are as follows; from the Observations of

| | 1 | 2 | 3 | 4 | |
|--|------------------|------------------|---------|-------------------|-----------------------------------|
| <i>Cassini</i> — — — — — | 5. | 8. | 13. | 23. | Semi-Diameter of <i>Jupiter</i> . |
| <i>Borellus</i> — — — — — | 5. $\frac{2}{3}$ | 8. $\frac{2}{3}$ | 14. | 24. $\frac{2}{3}$ | |
| Mr. <i>Townley</i> by the Micromet. | 5. 51 | 8. 78 | 13. 47 | 24. 72 | |
| Mr. <i>Flamsteed</i> by the Microm. | 5. 31 | 8. 85 | 13. 98 | 24. 23 | |
| Mr. <i>Flamsteed</i> by Eclip. of Sat. | 5. 578 | 8. 876 | 14. 159 | 24. 903 | |
| From the Periodical Terms | 5. 578 | 8. 876 | 14. 168 | 24. 968 | |

The Periodical Times are: Of the

| | Days. | Hours. | Min. | |
|--------|-------|--------|------|----------------|
| First | 1 | 18 | 28 | $\frac{1}{4}$ |
| Second | 3 | 13 | 17 | $\frac{9}{10}$ |
| Third | 7 | 3 | 59 | $\frac{1}{10}$ |
| Fourth | 16 | 18 | 5 | $\frac{1}{5}$ |

Vid. Newton's Princip.
pag. 403.

Mr. Flamsteed, in *Philos. Trans.* N^o 154. says, that when *Jupiter* is in a *Quartile* of the Sun, the Distance of the first Satellite from his next Limb, when it falls into his Shadow, and is eclipsed, is one Semi-Diameter of *Jupiter*; of the second, two, or a whole Diameter nearly; of the third, three; of the fourth, five of his Semi-Diameters, or something better, when the Parallax of the Orb is greatest: But these Quantities diminish gradually as he approaches the Conjunction or Opposition of the Sun somewhat nearly; but not exactly in the Proportion of Sines.

SATELLITES of *Saturn*. Anno 1684. in the Month of *March*, Mr. *Cassini*, by the Help of excellent Object-Glasses of 70, 90, 100, 136, 155, and of 220 Foot, discovered the two innermost; (that is, the first and second) *Satellites of Saturn*.

1. The first Satellite he observed to be never distant from *Saturn's* Ring, above $\frac{2}{3}$ of the apparent Length of the same Ring; and it was found to make one Revolution about *Saturn*, in one Day, 21 Hours, and 19 Minutes; making two Conjunctions with *Saturn*, in less than two Days; one in the upper Part of his Orb, and the other in the lower Part. It is distant from the Centre of *Saturn* $4\frac{2}{3}$ of *Saturn's* Semi-Diameter.

2. The second Satellite of *Saturn* was observed to be $\frac{1}{4}$ of the Length of his Ring distant therefrom, making his Revolution about him in two Days, 17 Hours, and 43 Minutes. This is distant from the Centre of *Saturn* $5\frac{2}{7}$ Semi Diameters of that Planet.

3. From a great Number of choice Observations he concluded, that the Proportion of the Digression of the second to that of the first, counting both from the Centre of *Saturn*, is as 22 to 17.

4. And the Time wherein the first makes its Revolution, is to the Time wherein the first makes its, as $24\frac{3}{4}$ to 17.

5. The third is distant from *Saturn*, eight of his Semi Diameters, and revolves round him in almost $4\frac{2}{3}$ Days.

6. The fourth, or *Hugenian* Satellite, as 'tis called, because discovered first by Mr. *Hugens*, revolves round *Saturn*, in about 16 Days, and is distant from his Centre about 18 Semi-Diameters of *Saturn*.

7. The fifth Satellite of *Saturn* is distant from his Centre 54 Semi-Diameters of *Saturn*; and revolves round him in 79 Days. The greatest Distance between this Satellite, and the preceding, made Mr. *Hugens* suspect here may be a sixth between these two; or else, that this fifth

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may have other Satellites moving round him.

8. Mr. Halley, in *Philos. Transf.* N^o 145. gives a Correction of the Theory of the Motion of the *Hugenian*, or fourth Satellite of *Saturn*, and makes the true Time of its Period to be 15 Days, 22 Hours, 41 Minutes, six Seconds; its Diurnal Motion, to be 22 Degrees, 34 Minutes, 38 Seconds, 18 Thirds, and the Distance of

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this Satellite from the Centre of *Saturn*, to be about four Diameters of the Ring, or nine of the Globe: and the Place where it moves, to differ little of nothing from that of the Ring; that is to say, intersecting the Orb of *Saturn* with an Angle 23 Degrees and a half; so as to be nearly parallel to the Earth's Equator.

The Periodical Times of the Satellites of Saturn, according to Mr. Cassini are, of the

| | Days. | Hours. | Min. |
|--------|-------|--------|------|
| First | 1 | 21 | 19 |
| Second | 2 | 17 | 43 |
| Third | 4 | 12 | 27 |
| Fourth | 15 | 23 | 15 |
| Fifth | 79 | 22 | 0 |

SATURN, is the highest of the Planets.

1. The Proportion of the Body of *Saturn* to our Earth is about 30 to 1.

2. The Periodical Time of *Saturn's* Revolution about the Sun in the Space of 30 Years, or 10950 Days.

3. The Semi Diameter of *Saturn's* Orbit is almost ten Times as big as that of the *Magnus Orbis*, and therefore is of *English Miles* 946969690.

4. According to Mr. Cassini, *Saturn's* greatest Distance from the Earth is 244330, his mean Distance 210000, and his least Distance 175670 Semi-Diameters of the Earth.

5. Mr. *Hugens* found the Inclination of the Ring of *Saturn* to the *Ecliptick*, to be an Angle of 31 Degrees.

6. Mr. *Azout* asserts, that the

remote Distance of *Saturn* from the Sun doth not hinder, but that there is Light enough to see clear there, and more than in our Earth in cloudy Weather.

7. In an Observation, which *Cassini* made June 19. 1692. of a precise Conjunction between a fix'd Star, and one of *Saturn's* Satellites, he saith, that with his 39 Foot-Glass he could plainly see the Shadow of *Saturn's* Globe to be in part Oval upon the hinder Part of his Ring. The Diameter of *Saturn* at the Time of this Observation, appeared to be 45 Seconds.

8. The Diameter of *Saturn* to the Ring, is as 4 to 9.

9. And the Diameter of the Ring seen from the Sun, would be but 50". And therefore, the Diameter of *Saturn* seen from thence would be but 11". As Mr. *Flamsteed* found by measuring

ring it. But *Sir Isaac Newton* thinks it ought rather to be accounted but as 10". or 9". because he supposes the Globe of *Saturn* to be a little dilated by the unequal Refrangibility of Light.

10. The Distance of *Saturn* from the Sun is about ten Times as great as that of our Earth from him; and therefore that Planet will not have above the 100th Part of the Influence of the Sun which we have; and consequently cannot be habitable by such Creatures as live on our Globe, unless there be some unknown Way of communicating Heat to him.

11. Dr. *Gregory*, in his *Astronomy*, makes the Semi-Diameter of the Ring of *Saturn* to that of the Planet; as $2\frac{1}{2}$ to 1.

12. And the Interstice between the Planet and the Ring, is the Breadth of the Ring.

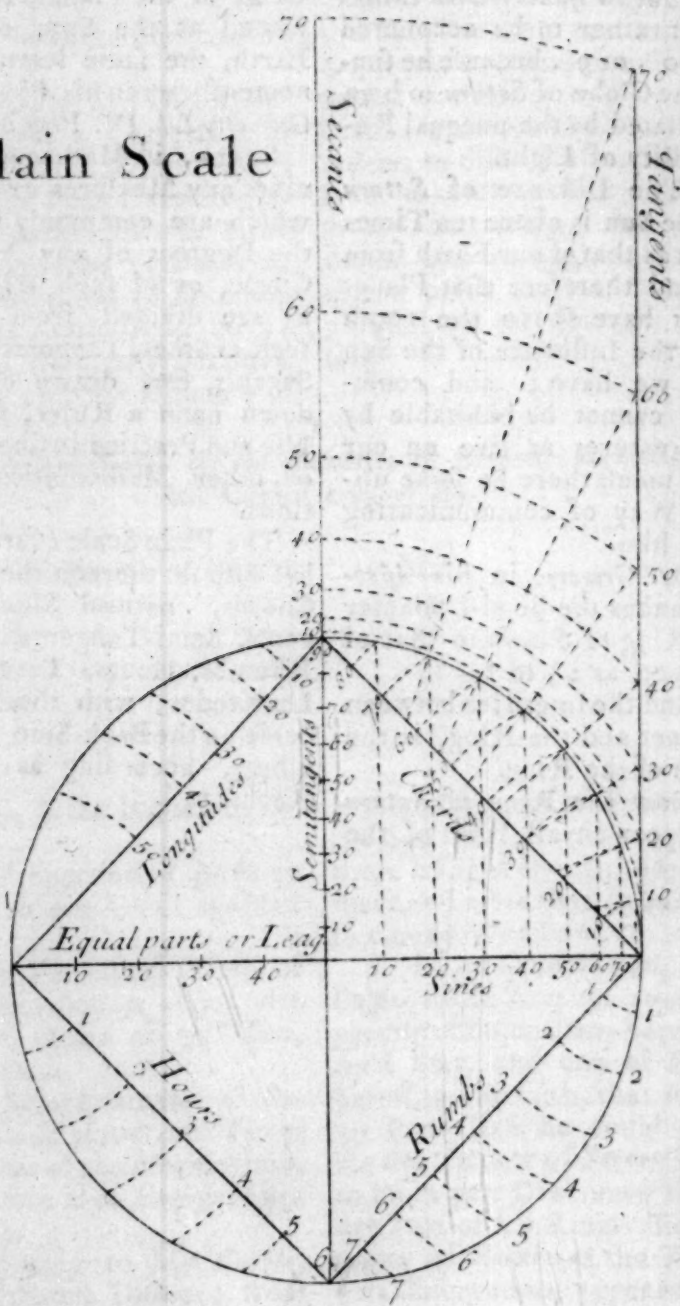
13. How the Ring of *Saturn* will appear in all Parts of the

Orbit of the Planet, to an Eye placed at the Sun, or at the Earth, the same learned Astronomer shews in his *Astro. Phy. &c. Geometr. Lib. IV. Prop. 69, 70.*

SCALE, in Mathematicks, signifies any Measures or Numbers which are commonly used; or, the Degrees of any Arch of a Circle, or of such Right Lines as are divided from thence; such as Sines, Tangents, Chords, Secants, &c. drawn or plotted down upon a Ruler, for ready Use and Practice in Geometrical, or other Mathematical Operations.

The Plain Scale (for Sea Use) has also set thereon the Scale of Chords, natural Sines, Tangents, Semi-Tangents, Seconds, Rhumbs, Hours, Leagues, and Longitudes; with the Diagonal Scale on the Back-Side, and some others, according as there is Room.

Plain Scale



SCALE of the Gamut, or *Musical Scale*, is a kind of Diagram, consisting of certain Lines and Spaces drawn to shew the several Degrees, whereby a Natural or Artificial Voice or Sound may either ascend or descend. The Name thereof is taken from the Greek Letter *Gamma*, which *Guido Aretinus*, who reduced the Greek Scale into this Form, placed at the Bottom, to signify from whence it was derived; so that ever since, this Scale or Gamut hath been taken for the Ground-Work, or first Foundation of all Musick, both Vocal and Instrumental.

But there were three different Scales in use among the Antients, which had their Denominations from the three several Sorts of Musick, viz. the *Diatonical*, *Chromatical*, and *Inharmonical*. Which see.

SCALENOUS CONES, are such whose Axes are at Right Angles to their Base.

SCALENOUS TRIANGLES. See *Triangles*.

SCAMILLI IMPARES, in Architecture, are certain Blocks or Zoccoes, which serve to elevate the rest of the Members of any Column or Statue, which was placed before the Horizon, i.e. beneath the Projectures of the *Stylolata Cornices*, and other *Saillies*, and will easily be conceived by considering the Pedestals of Statues, which do well represent them.

SCARP, in Fortification, is the Foot of the Rampart-Wall, or the Sloping of the Wall from the Bottom of the Work, to the Cordon on the Side of the Moat.

SCENOGRAPHY, in Perspective, the Scenographick Appearance

of any Figure, Body, or Building, is that Side, that declines from, or makes Angles with that Straight Line imagined to pass through the two outward Convex Points of the Eyes, generally called by Workmen, the Return of a Fore-right Side, and differs from the Orthographick Appearance in this, that the latter represents the Side of a Body or Building as it is seen, when the Plane of the Glass stands parallel to that Side: But Scenography represents it, as it seems, through a Glass not parallel to that Side.

In Architecture and Fortification, Scenography is the Manner of delineating the several Parts of a Building or Fortress, as they are represented in Perspective.

SCHEME, is the Representation of any Geometrical or Astronomical Figure or Problem, by Lines sensibly to the Eye, and these are otherwise called *Diagrams*.

SCHOLIUM, is a Discourse either declaring what Things are obscure in Definitions or Propositions, and their Corollaries; or else clearing up of Doubts that may arise; or shewing the Use of the Doctrine in hand, or lastly describing the History or Origine of an Invention.

SCIOGRAPHY, is the Art of Shadows, or Dialling: Also in Architecture, this Word is sometimes taken for the Draught of a Building cut in its Length or Breadth, to shew the Inside of it; as also the Thickness of the Walls, Vaults, Floors, Timber-Works, &c.

SCIOPTICKS, See *Obscura Camera*.

SCIOTHE

SCIOTHERICUM TELESCOPIUM, is an Horizontal Dial, with a Telescope adapted for observing the true Time both by Day and Night, to regulate and adjust Pendulum Clocks, Watches, and other Time-Keepers; invented by the ingenious Mr. *Molyneux*, who has published a Book with this Title, which contains an accurate Description of this Instrument, and all its Uses and Application.

SCONSES, are small Forts built for Defence of some Pass, River, or Place. Sometimes they are made regular of four, five, or six Bastions; others of smaller Dimensions fit for Passes, or Rivers, and likewise for the Field; which are,

1. Triangles with half Bastions, which may be all of equal Sides, or they may be something unequal. However it be, divide the Sides of the Triangle into two equal Parts, one of these three Parts will set off the Capitals, and the Gorges, and the Flanks being Right Angles with the Sides, make half of the Gorge.

2. Squares with half Bastions, whose Sides may be betwixt 100 and 200 Foot; and let one Third of the Side set off the Capital and the Gorges; but the Flank (which raise at Right Angles to the Side) must be but one half of the Gorge or Capital, that is, on the sixth Part of the Side of the Square.

3. Square with half Bastions and Tong.

4. Long Squares.

5. Star Redoubt, of four Points.

6. Star Redoubt, of five or six Points.

7. Plain Redoubts, which are either small or great: The small are fit for court Guards in the Trenches, and may be a Square of twenty Foot to thirty. The middle Sorts of Redoubts may have their Sides from thirty to fifty Feet: The great ones from sixty to eighty Feet square.

The Profile (that is, the Thickness and Height of the Breast-Works) to be set on these several Works, and the Ditches are alterable and uncertain; for sometimes they are used in Approaches, and then the Width of the Breast-Work at the Bottom may be seven or eight Foot, inward Height six, and outward five Foot. The Ditch may be eight or ten Foot, and sometimes twelve: And for the Slopes to be wrought according to the Nature of the Earth; sometimes they may be made fourteen or twenty Foot wide at the Bottom, and the Height of seven, eight or nine Foot, and to have two or three Ascents to rise to the Paraper: The Ditch may be sixteen or twenty-four Foot wide, and five or six deep; and sometimes they may come near the smallest Sort of Ramparts, and have a Breast-Work cannon-proof, with a Ditch of fifty or sixty Foot wide, and are thus made to set upon Passes or Rivers to endure.

SCORE, in Musick, is the original Draught of the whole Composition, wherein the several Parts, *viz.* Treble, Second Treble, Base, &c. are distinctly scored or marked.

SCORPIO, is the Eighth Sign of the *Zodiack*, being usually marked thus (*♏*).

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SCOTIA, in Architecture, is a certain Member hollowed in form of a Demi-Channel, which is placed between the Torus, and the Astragal in the Bases of Pillars; as also sometimes under the Larmier or Drip, in the Cornice of the *Dorick* Order.

SCREW } is one of the me-
SCRUE, } chanical Powers, consisting of a Cylinder sulcated or hollowed in a Spiral Manner, and moving or turning in a Box or Nut, cut so as to answer to it exactly.

In the Screw, The Power is to the Resistance: As the said Distance between two Threads to the Periphery of a Circle, run through by that Point of the Handle to which the Power is applied.

SCROWLES, or **VOLUTES**, a Term in Architecture. See *Volutes*.

SEA-QUADRANT. See *Back-Staff*.

SECANT, is the Line drawn from the Centre of a Circle, cutting it, and meeting with the Tangent without.

SECOND, is the sixtieth Part of a Minute:

SECONDARY CIRCLES, in reference to the *Ecliptick*, or Circles of Longitude of the Stars, are such as passing through the Poles of the *Ecliptick*, are at Right Angles to the *Ecliptick*, (as the *Meridian* and Hour-Circles are to the *Equinoctial*.) By the help of these (infinitely many Circles) all Points in the Heavens are referred to the *Ecliptick*: That is, any Star or Phenomenon. And if two Stars, &c. are thus referred to the same Point of the *Ecliptick*, they are said to be in Conjunction, if in opposite Points, they are said to be in Opposition: If

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they are referred to two Points at a Quadrant's Distance, they are said to be in a *Quartile Aspect*; if the Points differ a sixth Part of the *Ecliptick*, the Stars are said to be in a *Sextile Aspect*, &c.

And, in general, all Circles which intersect one of the six greater Circles of the *Sphere* at Right-angles, may be called *Secondary Circles*; as the *Azimuths* or *Vertical Circles* in respect of the *Horizon*, &c.

SECONDARY PLANETS, are such as move round others, whom they respect as the Centre of their Motion, tho' they move also along with the Primary Planets in the annual Orbit round the Sun; and these are otherwise called the *Satellites*, such as the Moon to the Earth: And *Jupiter* hath four moving round him; as *Saturn* according to *Cassini*, hath five; *Mars*, *Venus* and *Mercury*, have no Secondary Planets moving round them, that have been yet discovered.

SECTION CONICK. See *Conick Section*.

SECTION, in Mathematicks, signifies the cutting of one Plane by another, or a Solid by a Plane.

The common Section of two Planes is always a Right-line, being the Line supposed to be drawn on one Plane by the Section of the other, or by its Entrance into it.

SECTION of a Building, in Architecture, is understood of the Profile and Delineation of its Heights and Depths raised on a Plane; as if the Fabrick were cut asunder to discover the Inside.

SECTOR, is an Instrument made of Wood, Ivory, Brass, &c. with a Point

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a Point, and sometimes a Piece to turn out to make a true Square, with Lines of Sines, Tangents, Secants, equal Parts, Rhumbs, Polygons, Hours, Latitudes, Metals, Solids, &c. and is generally useful in all the practical Parts of the Mathematics, and particularly contrived for Navigation, Surveying, Astronomy, Dialling, Projection of the Sphere, &c. by *Gunter, Foster, Collins*, and others. There are likewise Sectors for Fortification and Gunnery, by *Sir Jonas Moor*.

The great Advantage of the Sector above any Rule or Scale, is that all its Lines can be accommodated to any Radius; which is done by taking off all Divisions parallelwise and not lengthwise. The Ground of which Practice is this, that Parallels to the Base of any Plain Triangle, bear the same Proportion to it: : as the Parts of the Legs above the Parallel do to the whole Legs.

SECTOR of a Circle, is a mixt Triangle comprehended between the Radius and an Arch of the Circle.

SECUNDANS, in Mathematics, is an infinite Series of Numbers, beginning from nothing, proceeding as the Squares of Numbers in Arithmetical Proportion. As for Instance,

0, 2, 4, 9, 16, 25, 36, 49, 64, &c.

SEGMENT of a Circle, is a Figure contained between a Chord and an Arch of the same Circle.

SEGMENT of a Sphere, is a Part of it cut off by a Plane; and therefore the Base of such a Segment must always be a Cir-

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cle, and its Superficies a Part of the Surface of the Sphere.

Its Solid Content is found by multiplying the Surface of the whole Sphere, by the Altitude of the Segment, and then dividing the Product by the Diameter of the Square, and to the Quotient adding the Area of the Base of the Segment.

SEMI-BREVE, a Term in Music. See *Notes* and *Time*.

SEMI-CIRCLE, is the Figure contained between the Diameter of a Circle, and half the Circumference.

Also an Instrument for surveying, made of Brass, and divided into 180 Degrees, being half the Theodolite.

SEMI-CUBICAL PARABOLOID, is a Curve whose Ordinates are in Subtriplicate of the Duplicate Proportion of the Diameters: That is, the Cubes of the Ordinates are as the Squares of the Diameters.

In this Paraboloid, the Segments of the Curve, cut by Ordinates at equal Distances, are as the Ordinates in a Parabola; and therefore their Square is encreas'd by Equals in Arithmetical Progression: And consequently that Curve is to a Right-Line, as the Trunk of a Parabola to a Parabola.

SEMI-DIAMETER, or Radius, is that Line that is drawn from the Centre to the Circumference of a Circle.

SEMI-DIAMETER, in Fortification, is two-fold, viz. the greater and lesser: The former being a Line composed of the Capital, and the small Semi-Diameter of the Polygon; and the other, a Line drawn to the Circumference from the Centre through the Gorges.

SEMI-

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SEMI-DIAPASON, a Term in Musick, signifying a defective or imperfect Octave.

SEMI-DIAPENTE, in Musick, signifies an imperfect Fifth.

SEMI-DITONE, in Musick, is the lesser Third, having its Terms as six to five.

SEMI-QUADRATE, the same with Quartile.

SEMI-QUARTILE, an Aspect of the Planets when distant from each other 45 Degrees, or one Sign and an half.

SEMI-QUAVER, a Term in Musick. See *Notes and Time*.

SEMI-QUINTILE, an Aspect of the Planets, when at the Distance of 36 Degrees from one another.

SEMI-SEXTILE, an Aspect of the Planets when distant from one another 30 Degrees, or one Sign, and is noted thus, *SS*.

SEMI-TONE, a Term in Musick, of which there are two sorts, *viz.* a greater and lesser; the Inharmonical Deisis being the Difference between them.

SENSIBLE HORIZON. See *Horizon*.

SENSIBLE POINT. See *Point Sensible*.

SERPENTARIUS, a Constellation in the Northern Hemisphere consisting of thirty Stars.

SEPTENTRIONAL SIGNS, are the first six Signs of the *Zodiack*, so called, because they decline

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towards the North from the Equinoctial, and are the same with *Boreal Signs*.

SERIES, properly speaking, is an orderly Process or Continuation of Things one after another. 'Tis commonly in Algebra connected with the Word *Infinite*, and thereby Infinite Series, is meant certain Progressions, or Ranks of Quantities, orderly proceeding, which make continual Approaches to, and if infinitely continued, would become equal to what is enquired after.

This Method took its Rise from the learned Dr. *Wallis's* Arithmetick of Infinites, and has been of late so pursued by several worthy Persons of our own Nation, especially the incomparable Sir *Isaac Newton*, that it is now one of the greatest Improvements of Algebra.

Every infinite Series may be summ'd up, if the Terms of it are expressed by a Fraction, the Factors of the Denominator, of which are taken from any Arithmetical Progression, and the Numerator be a Multinomeal whose Dimensions at least are less by two than those of the Denominator.

The following Account of the Method of *Increments* of Mr. *Cunns* being new, easy and plain, it will not be amiss to insert here.

LET Q be some Integral Quantity, equally encreasing by the constant Increment q , which let bear a finite Relation to Q .

Then if Q be the present Value of the Integral,
 $Q + q$ will be the First succeeding Value,
 $Q + 2q$ the Second,
 $Q + 3q$ the Third;
 $Q + nq$ the n^{th} .

And

And

And let these several successive Values, for Ease and Convenience, be denoted by the same Q accented underneath:

Then Q will be denoted by Q

$$Q + q \quad \text{by } Q$$

$$Q + 2q \quad \text{by } Q$$

$$Q + 3q \quad \text{by } Q$$

$$Q + nq \quad \text{by } Q_n$$

And in like manner whilst Q is the present Value of the Integral, the Value of Q immediately preceding the present, which, if you please to call the First Preceding, will be

$$\begin{array}{ll} \text{The Second} & Q - q \\ \text{The Third} & Q - 2q \\ \text{The } n^{\text{th}} & Q - nq \end{array}$$

And if you please to let these be denoted by the same Q accented above;

Then $Q - q$ will be denoted by Q

$$Q - 2q \quad \text{by } Q$$

$$Q - 3q \quad \text{by } Q$$

$$Q - nq \quad \text{by } Q_n$$

N. B. Dr. B. Taylor, and others, chose to denote the Increments by the same Letters with the Integrals; only for Distinction sake they point them beneath:

$$\text{So } q = Q$$

$$2q = Q$$

$$nq = Q$$

$$n + n = n$$

$$n + 2n = n$$

$$n + 3n = n$$

$$n + 4n = n$$

And

And then the Integral Quantities may be denoted by the small Letters; and the preceding and succeeding Values of Integrals by the Letters representing the present Values accented above and below: And to distinguish these Values of the Integral from like Values of Fluents, the Grave Accent is used instead of the Acute.

COR. From the very Notation itself, it follows, that if the Value of any given Integral be subtracted from its next succeeding Value, the Remainder is the Increment of that given Integral: And therefore to find the Increment of any given Integral, this is

The Rule.

Every where in the given Expression, instead of the Integrals, write their next succeeding Values, and from the Result take the given Expression, and the Remainder is the Increment sought.

Example I. So the Increment of n is $n - n = n + n - n = n$. And,

Example II. The Increment of nn is $nn - nn = n - n \times n = n + 2n - n \times n = 2nn$.

Example III. The Increment of nnn is $nnn - nnn = n - n \times nn = n + 5n - n - 2n \times nn = 3nnn$.

Example IV. In like manner, the Increment of $n n, \&c.$ till n is $n n, \&c.$ till $n - n n, \&c.$ till $n = n - n \times n n, \&c.$ till $n = n + \beta + 1 \times n - n - an \times n n, \&c.$ till $n = \beta - \alpha + 1 \times n \times n n, \&c.$ till n .

Example V. So the Increment of nnn is $nnn - nnn = n - n \times nn = n - n - n + 4n \times nn = 3nnn$.

Example

Example VI. And the Increment of n^{a-1} , &c. till n is n^{a-1} ,
 &c. till $n^{\beta-1}$ n^{a-1} , &c. till $n = n^{\beta-1} - n^{a-1} \times n^{a-2}$, &c. till
 $n = n^{\beta-1} - \beta - 1 \cdot n^{a-1} + \alpha n^{a-2} \times n^{a-2}$, &c. till $n =$
 $\alpha - \beta + 1 \cdot n^{a-1} n^{a-2}$, &c. till n .

Example VII. The Increment of $n n n n n$ (or of its Equal in
 the negative Notation $n n n n n$) is $n n n n n - n n n n n =$
 $n - n \times n n n n n = n + 4 n - n + 2 n \times n n n n n =$
 $6 n n n n n$.

COR. From the Fourth, Fifth, and Seventh Examples it follows, that the Increment of any Expression involving the successive Values of any one variable Quantity, is had thus:

Multiply the Expression by the Number of the Factors into the constant Increment of the variable Quantity; then divide by the first Value, and you have the Increment of the Expression.

COR. Hence, also, it naturally follows, that the Integral correspondent to any Increment, will be had thus:

Multiply by that Value of the variable Quantity which immediately precedes the first Value given; then divide by the new Number of Factors into the constant Increment, and you will have the Integral.

One Use of the preceding Principles, is to raise the Binomial Theorem.

1. The Form may be easily had by Induction: The Coefficients remain to be investigated; which suppose to be thus:

$$a+x|^m = a^m + r a^{m-1} x + s a^{m-2} x^2 + t a^{m-3} x^3 + v a^{m-4} x^4, \text{ \&c.}$$

Now, if we make m to increase uniformly by the Increment 1, and find the following State m , that is, when m becomes $m+1$; or which amounts to the same Thing, multiply the preceding Supposition by $a+x$, we shall have the Product.

$$a^{m+1} + r a^m x + s a^{m-1} x^2 + t a^{m-2} x^3 + v a^{m-3} x^4, \&c.$$

$$+ 1 a^m x + r a^{m-1} x^2 + s a^{m-2} x^3 + t a^{m-3} x^4, \&c.$$

In which $m = 1 = r$ whence $m = r$

Also $s = r = m$ $\therefore s = \frac{m m}{2}$

And $t = s = \frac{m m m}{2}$ $\therefore t = \frac{m m m}{3 \cdot 2}$

Likewise $v = t = \frac{m m m m}{3 \cdot 2}$ $\therefore v = \frac{m m m m}{4 \cdot 3 \cdot 2}$

Whence $(a + x)^m = a^m + m a^{m-1} x + \frac{m m}{2} a^{m-2} x^2 + \frac{m m m}{2 \cdot 3} a^{m-3} x^3, \&c.$

There are other Theorems for this Purpose, easily deduced from this: Such is this following; where A is the first Term, B the second, C the third, $\&c.$

$$(a + x)^m = a^m + \frac{m A x}{a + x} + \frac{\frac{m+1}{2} B x}{a + x} + \frac{\frac{m+2}{3} C x}{a + x}, \&c.$$

Of all the Varieties for this Purpose, every one hath some peculiar Property which the rest have not.

2. To raise the Infinitonómial to any Power in determin'd m .

Suppose it to be $A + B y + C y^2 + D y^3 + E y^4, \&c. =$

$$A \times 1 + \frac{B}{A} y + \frac{C}{A} y^2 + \frac{D}{A} y^3, \&c.$$

Which call $A \times 1 + b y + c y^2 + d y^3 + e y^4 + f y^5, \&c.$

Then for the Form of the Power, you may observe (by Induction) that the first Term will be always 1; the second, where the Index of y will be an Unit, cannot be formed by any of these Terms but the 1st and 2^d; and that the third Term, where the Index of y is 2, can be produced only by either squaring the 2^d, or multiplying the 3^d by the 1st Term. And the fourth, either by multiplying the 1st by the 4th, the 2^d by the 3^d, or the Cube of the 2^d; and so proceeding, taking all the possible Ways. And then

$$q = 1 = m \quad \therefore \quad q = m$$

$$r = 1 + g = 2m \quad \therefore \quad r = \frac{mm}{2}$$

$$s = b = m \quad \therefore \quad s = \frac{mm}{2}$$

$$t = n + k = mm + \frac{mm}{2} \quad \therefore \quad t = \frac{mmm}{3} + \frac{mmm}{2 \cdot 3}$$

$$v = p = \frac{mmm}{2 \cdot 3} \quad \therefore \quad v = \frac{mmmm}{4 \cdot 3 \cdot 2}$$

Now restore the Values of $b, c, d, e, \&c.$ and multiply by A^n ,
and restore the Values of $g, h, k, \&c.$ and it will be

$$\begin{aligned} & A^n \\ & + \frac{m}{1} A^{n-1} B y \\ & + \frac{m}{1} \times \frac{m-1}{2} A^{n-2} B^2 y^2 \\ & \quad + \frac{m}{1} A^{n-1} C y^2 \\ & + \frac{m}{1} \times \frac{m-1}{2} \times \frac{m-2}{3} A^{n-3} B^3 y^3 \\ & \quad + \frac{m}{1} \times \frac{m-1}{1} A^{n-2} B C y^3 \\ & \quad \quad + \frac{m}{1} A^{n-1} D y^3 \\ & + \frac{m}{1} \times \frac{m-1}{2} \times \frac{m-2}{3} \times \frac{m-3}{4} A^{n-4} B^4 y^4 \\ & \quad + \frac{m}{1} \times \frac{m-1}{2} \times \frac{m-2}{3} A^{n-3} B^2 C y^4 \\ & \quad \quad + \frac{m}{1} \times \frac{m-1}{2} A^{n-2} C^2 y^4 \\ & \quad \quad \quad + \frac{m}{1} \times \frac{m-1}{1} A^{n-2} B D y^4 \\ & \quad \quad \quad \quad + \frac{m}{1} A^{n-1} E y^4 \\ & \quad \quad \quad \quad \quad \&c. \end{aligned}$$

3. If the Terms of any Series be \bar{a} , $\bar{a} + x$, $\bar{a} + 2x$, &c. till $\bar{a} + nx$, and you require the Sum of all:

Let the Term next following the last (*viz.* $\bar{a} + \overline{n+1} \times x$) be called m ; then will m be the Increment of the Sum: And fo

$\frac{m m}{2 m} + A$, the Integral of m , will be the Sum it self. But when

the Term next following the last is a , then the Series is nothing.

Therefore when $m = a$, then $\left(\frac{m m}{2 m} + A, i. e. \right) \frac{a a}{2 a} + A = 0$.

$$\text{Whence } A = - \frac{a a}{2 a} = \frac{\overline{a-x} \times a}{2 x}.$$

Therefore the Sum fought is $\frac{m m}{2 m} - \frac{a a}{2 a}$.

Which, if c be the last Term, will be

$$\frac{c c}{2 c} - \frac{a a}{2 a} = \frac{c c a - c a a}{2 c a} = \frac{c c + c x - a a + a x}{2 x}$$

From the former Series \bar{a} , $\bar{a} + x$, &c. let there be found this $\bar{a} \times \overline{a+x}$, $\overline{a+x} \times \overline{a+2x}$, $\overline{a+2x} \times \overline{a+3x}$, $\overline{a+3x} \times \overline{a+4x}$, &c. till $\overline{a+nx} \times \overline{a+n+1x}$ to find the Sum of all.

Then let the Term immediately following the last be $m m$, which is the Increment of the Sum:

Therefore the Sum is $\frac{m m m}{3 m} + A$.

When that which immediately follows the last is $a a$ the Sum is = nothing.

Threfore, writing $a a$ for $m m$, the Sum

$$\frac{a a a}{3 a} + A = 0 \quad \therefore \quad A = - \frac{a a a}{3 a}$$

Con-

Consequently $\frac{m m m}{3 m} - \frac{a a a}{3 a}$ is the Sum sought:

Where if c be the last Term of the Arithmetick Series, it will be

$$\frac{c c c}{3 c} - \frac{a a a}{3 a} = \frac{c^3 + x^2 a - c x^2 - a^3}{3 c}$$

Also from the same Series, viz. $a, a+x, &c.$ let this be form'd: $a \times a+x \times a+2x \times a+3x, a+x \times a+2x \times a+3x \times a+4x, &c.$ till $a+nx \times a+n+1x \times a+n+2x \times a+n+3x.$

Let the Term immediately following the last be $m m m m$, which is the Increment of the Sum;

And the Integral $\frac{m m m m m}{5 m} + A$ is the Sum.

But when the Term next following the last is $a a a a$, the Series is 0.

Therefore $\frac{a a a a a}{5 a} + A = 0 \therefore A = -\frac{a a a a a}{5 a}$

Consequently $\frac{m m m m m}{5 m} - \frac{a a a a a}{5 a}$ is the Sum sought.

Or, $\frac{c c c c c}{5 c} - \frac{a a a a a}{5 a}$, if c be the last Term in the Arithmetick Series.

Other Examples of putting variable Quantities into Increments.

Example 8. The Increment of $\frac{1}{n} = \frac{1}{n} - \frac{1}{n} = \frac{n-n}{n n} =$

$$\frac{n-n-n}{n n} = -\frac{n}{n n}$$

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Exam-

Example 9. The Increment of $\frac{I}{n n n}$ is $\frac{I}{n n n} = \frac{I}{n n n} =$

$$\frac{n n n - n n n}{n n n} = \frac{n - n \times n n}{n n n} = \frac{n - n}{n n n} = \frac{n - n - 3 n}{n n n} =$$

$$\frac{-3 n}{n n n}$$

Example 10. The Increment of

$$\frac{I}{z z \text{ \&c. till } z}$$

is $\frac{I}{z z \text{ \&c. till } z z} - \frac{I}{z z \text{ \&c. till } z} =$

$$\frac{z z \text{ \&c. till } z}{a a+1} - \frac{z z \text{ \&c. till } z z}{\beta \beta+1} = \frac{z - z \text{ \&c. } \times z \text{ \&c. } z}{a a+1 \beta \beta+1}$$

$$\frac{z z^2, \text{ \&c. till } z^2 z}{a a+1 \beta \beta+1} = \frac{z z^2 \text{ \&c. till } z^2 z}{a a+1 \beta \beta+1}$$

$$= \frac{z - z}{a \beta+1} = \frac{z + a z - z - \beta + 1 z}{z, \text{ \&c. till } z}$$

$$\frac{\beta + 1 - a \times z}{z, \text{ \&c. till } z}$$

Therefore to put any successive Values, dividing Unity of a flowing Quantity into Increments, multiply the Expression by the Number of the Factors into the constant Increment of the variable Quantity: Then divide by that Value of the variable Quantity which next succeeds the last which is given, and change the Sign: So you will have the Increment.

COR. Hence also it naturally follows, that the Integral of any such Increment will be had thus:

Change the Sign, multiply by the last given Value of the variable Quantity, and divide by the new Number of Factors into the constant Increment, and you will have the Integral.

Example 11. The Increment of any Power $n n$ is $n n - n n =$

$$2 n n + n n.$$

Example 12. And the Increment of $n n n$ is $n n n - n n n =$

$$3 n^2 n + 3 n n^2 + n^3.$$

Exam-

Example 13. In like manner the Increment of

$(1 z^m + 2 z^{m-1} + 3 z^{m-2}, \&c. \text{ is}$

$(1 z^m + 2 z^{m-1} + 3 z^{m-2}, \&c. - (1 z^m - 2 z^{m-1} - 3 z^{m-2}, \&c.$

$$= (1 \times m z^{m-1} z + \frac{m m}{2} z^{m-2} z^2 + \frac{m m m}{2.3} z^{m-3} z^3, \&c.$$

$$+ (2 \times m z^{m-2} z + \frac{m m}{2} z^{m-3} z^2, \&c.$$

$$+ (3 \times m z^{m-3} z, \&c.$$

$$+ \&c. \times \&c.$$

From these Examples it is evident, that always the Index of the highest Power of the variable Quantity in the Increment is less by an Unit than the Index of the highest Power of the Integral; and that the other succeeding Terms descend as the Binomial Theorem for raising integral Powers; and consequently, the Form of the Integral of any Power is known.

Wherefore, if it be required to find the Integral of

$$(1 z^m + 2 z^{m-1} + 3 z^{m-2} + 4 z^{m-3}, \&c.$$

we may with Safety put it

$$\alpha z^m + \beta z^{m-1} + \gamma z^{m-2} + \delta z^{m-3} + \varepsilon z^{m-4}, \&c.$$

where m 's Increment is an Unit. And then to determine the Coefficients, $\alpha, \beta, \gamma, \&c.$ we have

$$(1 z^m + 2 z^{m-1} + 3 z^{m-2} + 4 z^{m-3}, \&c.)$$

$$= \alpha \times m z^m + \frac{m m}{2} z^{m-1} z + \frac{m m m}{2.3} z^{m-2} z^2 + \frac{m m m m}{2.3.4} z^{m-3} z^3, \&c.$$

$$+ \beta \times m z^{m-1} + \frac{m m}{2} z^{m-2} z^2 + \frac{m m m}{2.3} z^{m-3} z^3, \&c.$$

$$+ \gamma \times m z^{m-2} + \frac{m m}{2} z^{m-3} z^2, \&c.$$

$$+ \delta \times m z^{m-3}, \&c.$$

Therefore

$$a = \frac{(1}{m} \times z^{-1}$$

$$\beta = \frac{(2}{m} - \frac{(1}{m} \times \frac{m}{2} \times z^2$$

$$\gamma = \frac{(3}{m} - \frac{(1}{m} \times \frac{m m}{2 \cdot 3} - \frac{\beta m}{2} \times z^3$$

$$\delta = \frac{(4}{m} - \frac{(1}{m} \times \frac{m m m}{2 \cdot 3 \cdot 4} - \frac{\beta m m}{2 \cdot 3} - \frac{\gamma m}{2} \times z^4$$

$$\epsilon = \frac{(5}{m} - \frac{(1}{m} \times \frac{m m m m}{2 \cdot 3 \cdot 4 \cdot 5} - \frac{\beta m m m}{2 \cdot 3 \cdot 4} - \frac{\gamma m m}{2 \cdot 3} - \frac{\delta m}{2} \times z^5$$

&c.

But if $a, \epsilon, \gamma, \&c.$ denote the Coefficients, exclusive of the Powers of z ,

$$a = \frac{(1}{m}$$

$$\beta = \frac{(2}{m} - \frac{(1}{m} \times \frac{m}{2}$$

$$\gamma = \frac{(3}{m} - \frac{(1}{m} \times \frac{m}{3} + \beta \times \frac{m}{2}$$

$$\delta = \frac{(4}{m} - \frac{(1}{m} \times \frac{m}{4} \times \beta \times \frac{m}{3} \times \gamma \times \frac{m}{2}$$

$$\epsilon = \frac{(5}{m} - \frac{(1}{m} \times \frac{m}{5} + \beta \times \frac{m}{4} \times \gamma \times \frac{m}{3} + \delta \times \frac{m}{2}$$

&c.

There-

Therefore if n denotes the Order of the Terms, the first will be

$\frac{(1}{m} z^m z^{-1}$ and either of the following Terms will be

$$\frac{(n}{m+2-n} - \frac{(}{n} + \beta \times \frac{m}{n} + \gamma \times \frac{m}{n} + \delta \times \frac{m}{n} \text{ &c. } \times z^{m+2-n} z^{-2}$$

In which Theorem we go on till a Value of $n = 2$, and the Number of the Terms will be $= m + 1$.

Hence, if there be a Series of Cubes whose Roots are in an Arithmetical Progression, and z^3 be put for the Term which immediately follows the last; to sum up such a Series, we must find the Integral of z^3 . In which Case $m = 3$, $(1 = 1$, and all the following Values of C , are nothings. Therefore

The first Term

$$\frac{(1}{m} z^m z^{-1} = \frac{1}{4} z^4 z^{-1}$$

The second Term

$$\frac{(n}{m+2-n} - \frac{(}{n} \times z^{m+2-n} z^{-2} = 0 = \frac{1}{2} \times z^3$$

The third Term

$$\frac{(n}{m+2-n} - \frac{(}{n} + \beta \times \frac{m}{n} \times z^{m+2-n} z^{-2} = 0 - \frac{1}{3} - \frac{1}{2} \times \frac{3}{2} \times z^2 z = + \frac{1}{4} z^2 z$$

The fourth Term

$$\frac{(n}{m+2-n} - \frac{(}{n} + \beta \times \frac{m}{n} + \gamma \times \frac{m}{n} \times z^{m+2-n} z^{-2} = 0 - \frac{1}{4} - \frac{1}{2} \times \frac{3}{3} + \frac{1}{4} \times \frac{2}{2} \times z z^2 = 0.$$

Therefore the Integral is $\frac{1}{4} z^4 z^{-1} - \frac{1}{2} z^3 + \frac{1}{4} z^2 z + A$.

But when n , the first Term in the Arithmetical Progression, is that which immediately follows the last, the Sum is nothing.

There-

Therefore $\frac{1}{4}a^4z^{-1} - \frac{1}{2}a^3 + \frac{1}{4}a^2z + A = 0$.

Whence $A = -\frac{1}{4}a^4z^{-1} + \frac{1}{2}a^3 - \frac{1}{4}a^2z$.

Therefore the Sum sought is,

$$\frac{1}{4}z^4z^{-1} - \frac{1}{2}z^3 + \frac{1}{4}z^2z - \frac{1}{4}a^4z^{-1} + \frac{1}{2}a^3 - \frac{1}{4}a^2z =$$

$$\frac{\frac{1}{4}z^3z^{-1} \times \overline{z-z}^2 - \frac{1}{4}a^2z^{-1} \times \overline{a-z}^2}{4z}$$

SERPENTINE LINE, the same with Spiral ; which see.

SESQUIALTER, in Musick. See Time.

SESQUIALTERAL PROPORTION, is when any Number or Quantity contains another once and an half ; and the Number so contained in the greater is said to be to it in subseqüialteral Proportion.

SESQUIQUADRATE, an Aspect or Position of the Planets, when they are at the Distance of four Signs and an half, or 135 Degrees, from each other.

SESQUIQUINTILE, an Aspect of the Planets, when 102 Degrees distant from each other.

SESQUITERTIONAL PROPORTION, is when any Number or Quantity contains another once and one Third.

SEXAGENARY TABLES, were Tables contrived (formerly) of Parts Proportional ; where, by Inspection, you may find the Product of two Sexagenaries to be multiplied, or the Quotient of two that are to be divided, &c.

SEXAGESIMAL FRACTIONS, or Sexagenaries, are such as have always 60 for their Denomina-

tors : There were antiently no others used in Astronomical Operations ; and they are still retained in many Cases, though Decimal Arithmetick begins to grow in use now in Astronomical Calculations.

SEXANGLE, in Geometry, is a Figure consisting of six Angles.

SEXTANS, is the sixth Part of any Thing : Thus, there is an Astronomical Instrument called a Sextant, as being the 6th Part of a Circle. This hath a graduated Limb, and is used like a Quadrant.

SEXTILE, the Position or Aspect of the Planets, when at 60 Degrees distance, or at the Distance of two Signs from one another ; and is marked thus*.

SHOULDRING, in Fortification, is a Retrenchment opposed to the Enemies, or a Work cast up for Defence on one side, whether it be made of Heaps of Earth cast up, or of Gabions and Fascines. A Shouldring also is a square Orillon sometimes made in the Bastions on the Flank near the Shoulder, to cover the Cannon of a Casemat. Again, it is taken for a Demi-Bastion or Work

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Work consisting of one Face, and one Flank, which ends in a Point at the Head of a Horn-work or Crown-work: Neither is it to be understood only of a small Flank added to the sides of the Horn-work, to defend them when they are too long, but also to the Redoubts which are raised on a strait Line.

SIDERAL YEAR. See *Solar Year*.

SILLON, in Fortification, is an Elevation of Earth, made in the Middle of a Moat, to fortify it when too broad: It is otherwise called *Envelope*, which is the more common Name.

SIMILAR, in Geometry, is the same as *like*.

SIMILAR ARCHES of a Circle, are such as are like Parts of their whole Circumferences.

SIMILAR BODIES, in natural Philosophy, are called such as have their Particles of the same Kind and Nature one with another.

SIMILAR Plane Numbers, are those Numbers which may be ranged into the Form of Similar Rectangles: That is, into Rectangles whose Sides are proportional, such are 12 and 48; for the Sides of 12 are 6 and 2. and the Sides of 48 are 12 and 4. But $6. 2 :: 12. 4$, and therefore those Numbers are Similar.

SIMILAR POLYGONS, are such as have their Angles severally equal, and the Sides about those Angles proportional.

SIMILAR RECTANGLES, are those which have their Sides about the equal Angles proportional.

1. All Squares are Similar Rectangles.

2. All Similar Rectangles are

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to each other as the Squares of their homologous Sides.

SIMILAR *Right-lin'd Figures*, are such as have equal Angles, and the Sides about those equal Angles proportional.

SIMILAR SEGMENTS of a Circle, are such as contain equal Angles.

SIMILAR CURVES. Two Segments of two Curves are called similar, if any Right-lined Figure, being inscribed within one of them, we can inscribe always a similar Right-lined Figure in the other.

SIMILAR CONICK-SECTION: Two Conick-Sections are said to be similar, when any Segment being taken in the one, we can assign always a similar Segment in the other.

SIMILAR DIAMETERS of two Conick-Sections. The Diameters in two Conick-Sections are said to be similar, when they make the same Angles with their Ordinates.

SIMILAR SOLIDS, are such that are contained under equal Numbers of similar Planes, alike situated.

SIMILAR TRIANGLES, are such as have all their three Angles respectively equal to one another.

1. All similar Triangles have the Sides about their equal Angles proportional.

2. All similar Triangles are to one another, as the Squares of their homologous Sides.

SIMPLE FLANK. See *Flank*.

SIMPLE PROBLEM, in Mathematicks. See *Linear one*.

SIMPLE QUANTITIES, in Algebra, are such as have but one Sign, whether positive or negative:

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five: Thus, $2a$, and $3b$, are simple Quantities.

But $a+b$, and $+d-c+b$ are compound ones.

SIMPLE TENAILLE. See *Tenaille*.

SINE, or *Right Sine*, is a Right Line drawn from one End of an Arch, perpendicularly upon the Diameter drawn from the other End of that Arch; or it is half the Chord of twice the Arch.

If the Radius be $=1$. then the Length of the Arch of a Quadrant will be 1.57070, &c. and the Square of it is 2.4694, &c. Now if this Square be divided by the Square of a Number expressing the Ratio of 90 Degrees to any given Angle, as A , and the Quotient be called z , three or four Terms of this Series

$$1 - \frac{z}{2} + \frac{zz}{24} - \frac{z^3}{720} + \frac{z^4}{40320}, \text{ \&c.}$$

will give the Cosine of the Angle A .

SINE COMPLEMENT. See *Complement*.

SINGLE, or *Simple Eccentricity*. See *Eccentricity*.

SINICAL QUADRANT, is made of Brass or Wood, with Lines drawn from each side intersecting one another with an Index, divided by Sines, also with ninety Degrees on the Limb, and two Sights to the Edge, to take the Altitude of the Sun. Sometimes instead of Sines, 'tis divided all into equal Parts; and is used by Seamen to solve by Inspection any Problem of Plain-sailing.

SYCHON, a Glass or Metalline crooked Pipe, Tube, or Cane. See *Syphon*.

SIRIUS, the Dog-Star, a bright Star of the first Magnitude in the Constellation *Canis Major*. Its

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Longitude is 99 Degrees, 47 Minutes, Latitude 39 Degrees 31 Minutes.

SLIDING RULES, or *Scales*, are Instruments to be used without Compasses, in Gauging, measuring, &c. having their Lines fitted so, as to answer Proportions by Inspection; they are very ingeniously contrived and applied by *Gunter*, *Partridge*, *Cogshall*, *Everad*, *Hunt*, and others, who have written particular Treatises about their Use and Application.

SOLAR COMET. See *Discus*.

SOLAR CYCLE. See *Cycle of the Sun*.

SOLAR SPOTS. See *Spots of the Sun*.

SOLAR YEAR, is either *Tropical* or *Siderial*.

Tropical Year, is that Space of Time, wherein the Sun returns again to the same Equinoctial, or Solstitial Point, which is always equal to 365 Days, five Hours, and about 55 Minutes.

The *Siderial Year*, is the Space wherein the Sun comes back to any particular fixed Star, which is about 366 Days, eight Hours, and nine Minutes.

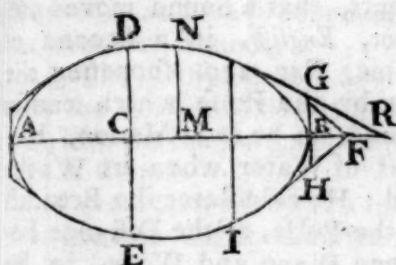
SOLID ANGLE, is an Angle made by the meeting of three or more Planes, and those joining in a Point, like the Point of a Diamond well cut.

SOLID BASTION. See *Bastion*.

SOLID, in Geometry, is the third Species of Magnitude, having three Dimensions, Length, Breadth, and Thickness, and is frequently used in the same Sense with Body; it may be conceived to be formed by the direct Motion, or the Revolution of any Superficies, of what Nature or Figure soever.

SOLID

SOLID of least Resistance. Sir *Isaac Newton*, in his *Principia*, p. 327. shews, that if there be a Curve-Figure, as *DNEB*, of such a Nature, as that from any Point, as *N*, taken in its Circumference, a Perpendicular *NM* be let fall to the Axis *AB*: And if, from a given Point, as *G*, the Right Line *GR*, be drawn parallel to a Tangent



to the Curve in that Point *N*: And also, if the Axis being produced, till *GR* cut it, it will then be as

$$MN : GR :: GR^3 : 4BG \times GR.$$

Then the Solid, which may be generated by the Revolution of this Curve round its Axis *AB*, when moved most swiftly in a rare and elastick Medium, shall meet with less Resistance from the Medium, than any Circular Solid whatsoever, described after the same Manner, and whose Length and Breadth are the same.

SOLID NUMBERS, are those which arise from the Multiplication of a plain Number, by any other whatsoever; as 18 is a Solid Number made of 6, (which is Plane) multiplied by 3; or of 9 multiplied by 2.

SOLID PLACE. See *Solid Locus*.

SOLID PROBLEM, in Mathematics, is one which cannot be

geometrically solved, by the Intersection of a Circle, and a Conick-Section; or by the Intersection of two other Conick-Sections besides the Circle.

1. As to describe an *Isoceles* Triangle on a given Right Line, whose Angle at the Base shall be triple to that at the Vertex.

2. This will help to inscribe a Regular Heptagon, in a given Circle; and may be resolved by the Intersection of a Parabola and a Circle.

3. The following Problem also helps to inscribe a Nonagon in a Circle; and may be solved by the Intersection of a Parabola, and an Hyperbola between its Asymptotes, viz.

4. To describe an *Isoceles* Triangle, whose Angle at the Base shall be quadruple of that at the Vertex.

5. And such a Problem as this hath four Solutions, and no more; because two Conick Sections can cut one another but in four Points. How all such Problems are constructed, Mr. *Halley* shews in *Philosoph. Transact.* N. 188-

SOLIDITY, (See *Firmness*) is a Quality of a Natural Body contrary to Fluidity, and appears to consist in the Parts of the Body's being interwoven and intangled one with another, so that they cannot diffuse themselves several ways, as Fluid Bodies can.

SOLSTICE, is the time when the Sun, entering the Tropical Points, is got furthest from the Equator, and before he returns back towards it, in the same Parallel, and scarce making any other Lines than perfect Circles, so small is its Progress.

These Solstices are two:

1. *Æstival*

1. *Æstival*, or Summer Solstice, when the Sun enters *Cancer*, *June 11.* making the longest Day, and the shortest Night.

2. And the *Hyemal*, or Winter Solstice, *December 11.* when he enters *Capricorn*, the Nights being then at the longest, and the Days at the shortest, that is, in Northern Regions; for under the *Equator* there is no Variation, but a continual Equinox; and in the Southern Parts, the Sun's Entrance into *Capricorn* makes the longest Day, and into *Cancer*, the longest Night.

SOLUTION, in Mathematicks, is the answering of any Question, of the Resolution of any Problem.

SOUND, seems to be produced by the subtiler and more ætherial Parts of the Air, being formed and modified into a great many small Masses or Contextures, exactly similar in Figure; which Contextures are made by the Collision and peculiar Motion of the sonorous Body, and flying off from it, are diffused all round in the Medium, and there do affect the Organ of our Ear in one and the same Manner.

Sound also appears not to be produced in the Air so much by the Swiftneſs, as by the very frequent Repercussions, and reciprocal Shakings of the sonorous Body.

Sir *Isaac Newton* demonstrates, (*Prop. 43. Lib. 2. of his Principles*;) that Sounds, because they arise from the tremulous Motion of Bodies, are nothing else but the Propagation of the Pulse of the Air: And this, he saith, is confirmed by those great Tremors that strong and grave Sounds excite in Bodies round about, as

the Ringing of Bells, Noise of Cannon, &c.

And in other Places he concludes, that Sounds do not consist in the Motion of any *Æther*, or finer Air, but in the Agitation of the whole common Air; because he found by Experiments, that the Motion of Sound depended on the Density of the whole Air.

He found by good Experiments, that a Sound moves 968 Foot, *English*, in a Second of Time, *Pag. 270.* supposing the Air by the Pulse which causes Sound, to be in a Motion, like that of Water when its Waves roll: He calculates the Breadth of the Pulse, or the Distance between Wave and Wave, to be in the Sounds of all open Pipes double the Length of those Pipes, which he grounds on an Experiment of Father *Mersennus*, in his *Harmonicks*, and that extended String made 104 Vibrations in a Second, when it was an unison with the C fault Pipe of an Organ, whose Length was four Foot open, and two Foot stopped 372.

Why the Sound ceases always with the Motion of the sonorous Body, and why they reach the Ear equally soon, when far off or near, he shews in *Prop. 48. Cor.* Where he proves, that the Number of the Pulses propagated, is always the very same with the Number of the Vibrations of the tremulous Body, and that they are not by any means multiplied as they go from it.

The following Properties have been observed of Sound; in many of which there is a near Relation between it and Light: For,

1. As Light acquaints the Eye with the different Qualities, Magnitudes, and Figures of Bodies, so Sound, in like manner, informs the Ear of many of the same Things in the sonorous Body.

2. As Light presently vanishes on the Removal, or total Eclipse of the Radiating Body, so a Sound perishes as soon as the Undulation of the Air ceases, which Motion both produces and preserveth all Sounds.

3. The Diffusion of Sound from the sonorous Body is spherical, like the Radiation of Light from its Centre.

4. A great Sound drowns a less, as a greater Light eclipses a less.

5. Too great, loud, or shrill a Sound is offensive and injurious to the Ear, as too great and bright a Light is to the Eye.

6. Sound also (like Light) moves sensibly from Place to Place, though nothing near so swift as Light: It is reflected like Light from all hard Bodies; it is hindered and refracted by passing through a denser Medium. But it differs from Light in this, That whereas Light is always propagated in Right-Lines, the Motion of Sound is almost always curvilinear.

7. Sound also differs much from Light in this, That it is very much weakened by Winds, and such-like Motions of the Air, which yet have no Effect on Light: For *Mersennus* computes, that the Diameter of the Sphere of a Sound heard against the Wind is near a third Part less, than when coming with the Wind.

8. A very small Quantity of Body serves to reflect the Rays of Light; as we perceive manifestly in small Pieces of Looking-Glasses, &c. But there appears to be necessary a Body of much larger Dimensions to return a Sound, or make an Echo.

9. As to the Reflections of Sounds, 'tis observed, that if one stand near the reflecting Body, and the Sound be not very far off, though an Echo be produced, yet it cannot be heard; because the Direct and Reflex Sound enter the Ear almost at the same time: But when the Sound appears to be stronger than ordinary, and lasts longer, especially when the Reflection is made from divers Bodies at once; as from Arches and vaulted Rooms, from whence the confused Sound of such-like Places arises.

And from hence probably may be deduced the Reason, why Concave Bodies are (*ceteris paribus*) fittest to produce great and clear Sounds, such as Bells, &c. For in such Bodies the Sound is very swiftly and very often reflected from side to side, and from one Part of the Cavity to another, and the Bell hanging at liberty, this produces great Tremblings and Shakings of the whole Concave Body, which occasions the Sound to continue till they cease and are quiet.

10. There is one Phænomenon *viz.* that Sounds great or small, with the Wind, or against it, from the same Distance, come to the Ear at the same time.

Dr. *Holder*, in his Book of the *Natural Grounds and Principles of Harmony*, says, That if the tremulous

mulous Motion which causeth Sound be uniform, then it produces a musical Note or Sound: But if it be difform, then it produces a Noise.

The *Florentine* Academicks found a Sound to move one of their Miles (*viz.* 3000 *Braccia*, or 5925 Foot) in five Seconds of Time: Therefore according to them, it moves 1185 Foot in one Second.

But Sir *Isaac Newton* found it to move but 968 Foot in one Second.

11. If the Air be agitated in any Manner, there arises a Motion analogous to the Motion of a Wave on the Surface of Water, which is called a *Wave of Air*.

12. And the Motion of these Waves is the Motion of a Sphere expanding itself in the same Manner as the Waves move circularly upon the Surface of the Water.

13. Whilst a Wave moves in the Air, wherever it passes, the Particles are removed from their Place, and return to it, running through a very short Space in going and coming.

14. Wherever the neighbouring Particles are not equally distant, the Motion arising from Elasticity, causes the less distant Particles to move towards those that are most distant.

15. Therefore, the Motion of the tremulous Body, by which the Air is agitated, ceasing, there are new Waves generated.

16. Waves, whether the Air be more or less agitated, are equally swift.

17. Waves, whether equal or any Way unequal, move with the same Velocity.

18. In Waves, the Squares of

their Celerities are inverfly as the Densities.

19. When the Density remains the same, but the Elasticity is changed, the Squares of the Celerities of the Waves are as the Degrees of the Elasticity.

20. If the Elasticity and the Density differ, the Squares of the Velocities of the Waves will be in a Ratio compounded of the direct Ratio of the Elasticity, and the inverse Ratio of the Density.

21. If the Density and the Elasticity increase or decrease in the same Ratio, the Celerity of the Waves will not be changed.

22. Therefore, from the changed Height of the Pillar of *Mercury*, which is sustained in a Tube void of Air by the Pressure of the Atmosphere, we must not judge the Celerity of the Waves to be changed.

23. For the Waves are moved with the same Celerity in the Top of a Mountain, as in a Valley.

24. The Waves move faster in Summer than in Winter.

25. By determining the Height of the Atmosphere, supposing it everywhere equally dense with the Air near the Earth, the Velocity of the Waves will be the same as a Body could acquire in falling from half that Height.

26. The Motion of Waves in the Air produces Sound.

27. A Body that is struck, continues to give a Sound some Time after the Blow.

28. The Celerity of the Sound is the same as the Celerity of the Waves, which strike the Ear.

29. The

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29. The Celerity of Sound is equable; yet in going through a great Space, it is sometimes accelerated or retarded.

30. The Celerity of Sound does not much differ, whether it goes with the Wind, or against it.

31. Therefore, Sound may be heard at a greater or smaller Distance, according to the Direction of the Wind.

32. *Ceteris paribus*, the Intensity of Sound is as the Space run through by the Particles in their going and coming.

33. Therefore, *Ceteris paribus*, the Intensity of Sound is as the Weight by which the Air is compressed.

34. If all Things remain as before, and the Elasticity be increased, the Intensity of Sound is directly as the Square Root of the Elasticity, and inversely as the Elasticity itself.

35. The Intensity of Sound is less in Summer than in Winter; yet in Summer, Bodies do more easily transmit Sound.

36. The Intensity of Sound, considered in general, is in a compound Ratio of the Space run through by the Particles, in their going backward and forward, of the Weight compressing the Air; and lastly, of the inverse Ratio of the Square Root of the Elasticity.

37. And the Degrees of the Sharpness of different Sounds are to one another, as the Number of the Waves which are produced in the Air at the same Time.

38. A Tone does not depend upon the Intensity of the Sound, and an agitated Cord gives the same Sound, whether it vibrates

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through a greater or a less Space.

39. Concords arise from the Agreement between the different Motions in the Air, which affect the Auditory Nerves at the same Time.

40. *Ceteris paribus*, if the Lengths of two Cords are as the Number of Returns in a Consonance, you will have the Consonance between the Sounds which the Strings produce.

41. And generally supposing any Cords of the same Kind, if the Ratio be compounded of the direct Ratio of the Lengths and of the Diameters, and the inverse Ratio of the Square-Roots of the Tensions, (be the Ratio between the Numbers of the Vibrations performed in the same Time in any Consonance whatever,) you will have that Consonance by the Agitation of those Cords:

42. An agitated String will communicate Motion to another, which performs two or three Vibrations, whilst the first performs but one.

SOUND, in Geography, is any great Indraught of the Sea, between two Headlands, where there is no Passage through.

SOUTH DIRECT DIALS. See *Prime Verticals*.

SOUTHERN SIGNS. See *Austral Signs*.

SPACE, if considered barely in Length between any two Beings, is the same Idea that we have of Distance; but if it be considered in Length, Breadth and Thickness, it is properly called Capacity; and when considered between the Extremities of Matter, which fills the Capacity of

A a Space

Space with something solid, tangible and moveable, or with Body, it is then called Extension; so that Extension is an Idea belonging to Body only. But Space, in a general Signification, is the same Thing with Distance, considered every Way, whether there be any solid Matter in it, or not.

Space, therefore, is either Absolute or Relative.

ABSOLUTE SPACE, considered in its own Nature, and without Regard to any Thing external, always remains the same, and is immoveable; but Relative Space is that moveable Dimension or Measure of the former, which our Senses define by its Positions to Bodies within it: And this the Vulgar use for immoveable Space.

RELATIVE SPACE, in Magnitude and Figure, is always the same with Absolute, but 'tis not necessary it should be so numerically. Thus, if you suppose a Ship to be indeed in absolute Rest, then the Places of all Things within her will be the same absolutely and relatively, and nothing will change its Place. But then suppose a Ship under Sail, or in Motion, and she will continually pass through new Parts of absolute Space; but all Things on board considered relatively, in respect to the Ship, may be notwithstanding in the same Places, or have the same Situation and Position, in regard to one another.

SPECIES, in Algebra, are those Letters, Notes, Marks, or Symbols, which represent the Quantities in any Equation or Demonstration. This short and advantageous Way of Notation was introduced by *Vieta*, about the

Year 1590, and by it made many Discoveries in the Process of Algebra, not before taken notice of.

The Reason why *Vieta* gave this Name of Species to the Letters of the Alphabet subservient to Algebra, and why he calls it *Arithmetica speciosa*, seems to have been in imitation of the Civilians, who call Cases in Law, but abstractedly, between *John a Nokes* and *Tom a Stiles*, between *A* and *C*; supposing those Letters to stand for any Persons indefinitely; such Cases, I say, they call Species: Wherefore since the Letters of the Alphabet will also as well represent Quantities, as Persons, and that too indefinitely one Quantity as well as another, they may properly enough be called Species; that is, Symbols, Marks, or Characters. From whence the literal Algebra is frequently nowadays called Specious Arithmetick, or Algebra in Species.

SPECIFICK, is in general whatever is peculiar to any distinct Species of Things, and which distinguishes them from all others of different Species; therefore the Logicians say, that in every good Definition of any Thing, the Specifick Difference ought always to be inserted.

SPECIFICK GRAVITY, is the appropriate and peculiar Gravity or Weight which any Species of natural Bodies have, and by which they are plainly distinguishable from all other Bodies of different Kinds. By some 'tis not improperly called *Relative Gravity*, to distinguish it from *Absolute Gravity*, which increases in proportion to the Bigness of the Body weighed.

SPHERE,

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SPHERE, is a solid Body made by the Rotation of a Semi-Circle about its Diameter.

1. All Spheres are to one another, as the Cubes of their Diameters.

2. The Solidity of a Sphere is equal to the Surface multiplied into one Third of the Radius.

3. The Surface of the Sphere is equal to four Times the Area of a great Circle of it.

4. As 2904 to 49, so is the Cube of the Circumference of a Sphere to its solid Content.

5. As 22 is to 7, so is the Square of the Circumference of the greatest Circle of a Sphere to the superficial Area of the Sphere.

6. As 21 is to the Sine, so is 11 Times the Square of that Sine added to 33 Times the Square of half the Cord of any Segment of a Sphere to the solid Content of that Segment.

7. As 14 is to 44 Times the Diameter of any Sphere, so is the Length of the Sine of any Segment of it, to the Convex Superficies of the said Segment.

8. An entire Glass Sphere will unite the Parallel Rays of an Object at the Distance of near its Semi-Diameter behind it.

SPHERE of Activity of any Body, is that Determinate Space or Extent all round about it, to which, and no farther, the Effluvia continually emitted from that Body do reach, and where they operate according to their Nature.

SPHERICAL NUMBERS. See *Circular Numbers.*

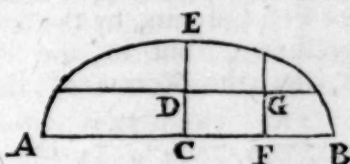
SPHERICK GEOMETRY, or PROJECTION, is the Art of Describing on a Plane the Circles of the Sphere, or any Parts

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of them in their just Position and Proportion, and of measuring their Arches and Angles when projected.

SPHEROID, is a solid Figure made by the Rotation of a Semi-Ellipsis about its Axis.

1. If *AEB* be a Spheroid generated by the Revolution of the Ellipsis *AEB* about the Axis *AB*,



and if it be cut by four Planes, *AB* passing through the Axis; *DG* parallel to *AB*, *CDE*, perpendicularly bisecting the Axis; and *EG* parallel to *CE*; and if the Right Line $CB=a$, $CE=c$, $CF=x$, and $FG=y$: Then the Segment *CDGF* of the Spheroid comprehended under the said Planes will be

$$= 2cxy - \frac{x}{3c}y^3 - \frac{x}{20c^3}y^5 - \frac{x}{56c^5}y^7 - \frac{5x}{576c^7}y^9 - \text{Ec.}$$

$$- \frac{cx^3}{3aa} - \frac{x^3}{18caa} - \frac{x^3}{40c^3aa} - \frac{5x^3}{336^5aa} - \text{Ec.}$$

$$- \frac{cx^5}{20a^4} - \frac{x^5}{40ca^4} - \frac{3x^5}{160c^3a^4} - \text{Ec.}$$

$$- \frac{cx^7}{56a^6} - \frac{5x^7}{336ca^6} - \text{Ec.}$$

$$- \frac{5cx^9}{576a^8} - \text{Ec.}$$

2. Where the Numeral Co-Efficients of the upper Terms

$$\left(2, -\frac{1}{3}, -\frac{1}{20}, \frac{1}{56}, \text{Ec.} \right)$$

are produced by multiplying the first Co-Efficient 2 by the Terms of this

A a 2

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this Progression $\frac{1 \times 2}{2 \times 3}, \frac{1 \times 3}{4 \times 5},$

$\frac{3 \times 5}{6 \times 7}, \frac{5 \times 7}{8 \times 9}, \frac{7 \times 9}{10 \times 11}, \&c.$ and

the Numeral Co-Efficients of the Terms in each Column of the Describing Terms are produced, by multiplying continually the Co-Efficients of the upper Term in the first Column, by the same Progression; but in the second, by the Terms of this,

$\frac{1 \times 1}{2 \times 3}, \frac{3 \times 3}{4 \times 5}, \frac{5 \times 5}{6 \times 7}, \frac{7 \times 7}{8 \times 9}, \&c.$

In the third, by the Terms of this,

$\frac{0 \times 7}{8 \times 9}, \frac{3 \times 1}{2 \times 3}, \frac{5 \times 3}{4 \times 5}, \frac{7 \times 5}{6 \times 7}, \frac{9 \times 7}{8 \times 9}, \&c.$

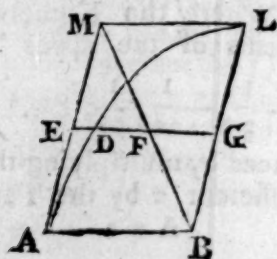
In the fourth, by the Terms

of this, $\frac{5 \times 1}{2 \times 3}, \frac{7 \times 3}{4 \times 5}, \frac{9 \times 5}{6 \times 7}, \&c.$ And

In the fifth, by the Terms

of this, $\frac{7 \times 1}{2 \times 3}, \frac{9 \times 3}{4 \times 5}, \frac{11 \times 5}{6 \times 7}, \&c.$

3. A Spheroid generated by an Ellipsis revolving upon the Diameter thereof, is $\frac{2}{3}$ of its Circumscribing Cylinder. Suppose $ADLB$ be a Quadrant of an Ellipsis, then if the whole Figure (AL) is conceived to revolve upon the Semi-Diameter BL , the Semi-Ellipsis ALB , will describe a Semi-Spheroid, and the Parallelogram $AMLB$ a Cylinder; and lastly, the Triangle MBL a Cone, all having the



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same Base and Altitude. Now, draw any Line EG parallel to the Base, and call BG, a ; the Semi-Diameter BL, s ; and the Semi-Conjugate $AB=q$; then

$$s:(BL)::q(ML):a(BG):\frac{aq}{s}(EG).$$

Again, from the Property of the Ellipsis, as $ss(\overline{BL}^2):qq(\overline{AB}^2)::$

$$ss-aa(BG+BL \times BL-BG):$$

$$\frac{qqss-qqaa}{ss}(\overline{DG}^2); \text{ therefore,}$$

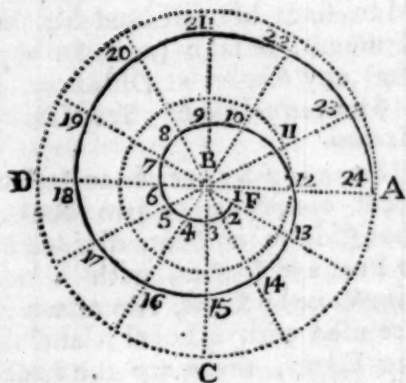
$$\frac{aaqq}{ss}(\overline{EG}^2) + \frac{qqss-qqaa}{ss} = qq.$$

that is, the Square of $EG = \overline{DG} + \overline{EG}^2$ Whence,

4. The Circle made by the Revolution of (EG) will be equal to the Annulus described by (hD) and the Sum of all the Circles (EG) that is, the Solidity of the Cone will be equal to the Sum of all the Annuli, that is, the Excess by which the Cylinder exceeds the Spheroid. Therefore, the Proposition is manifest, that a Spheroid, generated by an Ellipsis, revolving upon any Diameter thereof, is two Thirds of its Circumscribing Cylinder Q, E, D .

SPIRAL LINE, in Geometry, is, according to Archimedes thus generated.

1. If a Right Line, as AB , having one End fixed at B , be equally moved round, so as with the other End A , to describe the Periphery of a Circle; and at the same Time a Point be conceived to move forward equally from B towards A in the Right Line BA , so as that the Point describes that Line, while the Line generates the Circle; then will the Point, with its two Motions, describe the Curve-Line



B, 1, 2, 3, 4, 5, &c. which is called an *Helix*, or *Spiral Line*; and the plain Space contained between the Spiral-Line and the Right-Line *BA*, is called the *Spiral Space*.

2. If also you conceive the Point *B* to move twice as slow as the Line *AB*, so as that it shall get but half Way along *BA*, when that Line shall have formed the Circle, and if then you imagine a new Revolution to be made of the Line carrying the Point, so that they shall end their Motion at last together ; there will be formed a Double Spiral Line, and two Spiral Spaces, as you see in the Figure.

3. The Lines B_{12} , B_{11} , B_{10} , &c. making equal Angles with the first and second Spiral, (as also B_{12} , B_{10} , B_8 , &c.) are in Arithmetical Proportion.

4. The Lines $B7$, $B10$, &c. drawn any how to the first Spiral, are to one another as the Arches of the Circle intercepted betwixt BA , and those Lines.

5. Any Lines drawn from B to the second Spiral, as B 18, B 22, &c. are to each other, as the aforesaid Arches, together with the whole Periphery added on both Sides.

6. The first Spiral Space, is to the first Circle, as 1 to 3.

7. The first Spiral Line is equal to half the Periphery of the first Circle; for the Radii of the Sectors, and consequently the Arches are in a simple Arithmetick Progression, while the Periphery of the Circle contains as many Arches equal to the greatest; wherefore the Periphery to all those Arches is to the Spiral Line, as 2 to 1.

SPIRALS (PROPORTIONAL,) are such Spiral Lines as the Rhumb Lines on the Terrestrial Globe.

SPRING-ARBOR, in a Watch, is that Part in the Middle of the Spring-Box, which the Spring is wound or turn'd about, and to which it is hooked at one End.

SPRING-Box, is that Cylindrical Case or Frame that contains within it the Spring of a Watch, or other Movement.

SPRING-TIDE, is the Increasing higher of a Tide after a Dead Neipe : This is about three Days before the Full or Change of the Moon ; but the Top, or highest of the Spring Tide is three Days after the Full or Change ; then the Water runs highest with the Flood, and lowest with the Fbb, and the Tides run more strong and swift than in the Neipes.

SPRINGY; the same as *Elastick*.
Which see.

SPUNGING, of a great Gun, is clearing of her Inside, after she hath been discharged, with a Wad of Sheep Skins, or the like, rolled about one End of the Rammer: Its Design is to prevent any Parts of Fire from remaining in her; which would endanger the Life of him who should load, or charge her again.

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SQUARE, is an Instrument of Brass, or Wood, having one Side perpendicular, or at Right Angles to the other; sometimes made with a Joint to fold for the Pocket, and sometimes has a Back to use on a Drawing-Board, to guide the Square.

SQUARE FIGURE, in Geometry, is one whose Right-lined Sides are all equal, and its Angles all right. See *Quadrilateral Figure* for its Area. See *Area*.

SQUARING. By the Word Squaring, Mathematicians understand the making of a Square equal to a Circle. Thus the Quadrature or Squaring of the Circle, is the finding a Square equal to the Area of a Circle.

STAR, in Fortification, is a Work with several Faces generally composed of from five to eight Points, with salient and re-entrant Angles flanking one another, every one of its Sides containing from 12 to 25 Fathoms.

STAR-FORT. See *Fort*.

STARS. See *Fixed Stars*.

STATICAL BAROSCOPE. See *Baroscope*.

STATICAL HYGROSCOPE. See *Hygroscope*.

STATICKS, is a Science purely Speculative, being a Species of Mechanicks conversant about Weights, and shewing the Properties of the Heaviness and Lightness, or *Æquilibria* of Bodies: When it is restrained to the Specifick Weights and *Æquilibria* of Liquors, it is called Hydrostaticks. Which See.

STATION, in Astronomy signifies certain Places of the Zodiack, where a Planet being arrived, seems to stand still for some Time in the same Degree, either in ascending to its Apogee, or descending to its Perigee.

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STATION, is a Place where a Man fixes himself and his Instrument, to take (as in Surveying) any Angles or Distances.

STATION-LINE. See *Line of Station*.

STATION-STAFF, is an Instrument consisting of two Rulers that slide to ten Foot, divided into Feet and Inches, with a moving Vane or Sight, two of which are used with a Level; and on the Edges, there are the Links of *Gunter's Chain* divided. It is used in Surveying, for the more easy taking Off-sets.

STATIONARY: A Planet is said to be Stationary, when, to any Eye placed on Earth, it appears for some Time to stand still, and to have no progressive Motion forward in its Orbit round the Sun.

STENTOROPHONICK TUBE, or Instrument, is the Speaking-Trumpet, invented by Sir Samuel Moreland.

STEREOBATA, in Architecture, is the Greek Word for the first Beginning of the Wall of any Building, and immediately standing on the Foundation. This is wrongly confounded with *Stylobata*, which is the Beginning of a Column, or its Pedestal.

STEREOGRAPHY, is the Art of drawing the Forms of Solids upon a Plane.

SEREOGRAPHICK Projection of the Sphere, is the Projection of the Circles of the Sphere upon the Plane of some one great Circle, the Eye being in the Pole of that Circle.

In this Projection, a Right Circle is projected into a Line of Half Tangents.

The Representation of a Right Circle, perpendicularly opposed

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to the Eye, will be a Circle in the Plane of the Projection.

The Representation of a Circle placed oblique to the Eye, will be a Circle in the Plane of the Projection.

If a great Circle be to be projected upon the Plane of another great Circle, its Centre shall lie in the Line of Measures, distant from the Centre of the Primitive by the Tangent of its Elevation above the Plane of the Primitive.

If a lesser Circle, whose Poles lie in the Plane of the Projection, were to be projected; the Centre of its Representation shall be in the Line of Measures, distant from the Centre of the Primitive, by the secant of that lesser Circles Distance from its Pole, and its Semidiameter or Radius shall be equal to the Tangent of that Distance.

If a lesser Circle were to be projected, whose Poles lie not in the Plane of the Projection, its Diameter in the Projection, if it falls on each Side of the Pole of the Primitive, will be equal to the Sum of the Half Tangents of its greatest and nearest Distance from the Pole of the primitive, set each Way from the Centre of the primitive in the Line of Measures.

If a lesser Circle, to be projected, fall entirely on one Side of the Pole of the Projection, and do not encompass it, then will its Diameter be equal to the Difference of the Half Tangents of its greatest and nearest Distance from the Pole of the Primitive, set off from the Centre of the Primitive one and the same Way in the Line of Measures.

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In the Stereographick Projection, the Angles made by the Circles on the Surface of the Sphere, are equal to the Angles made by their Representatives in the Plane of their Projection.

STILE, in Dialling, is the Gnomon, or Cock of a Dial, that casts the Shadow upon the Hour-Lines, and is always parallel to the Axis of the Earth in all kinds of Dials.

STRAIT, or *Streight*, in Hydrography, is a narrow Sea shut up between Lands on either side, affording a Passage from one great Sea into another, as the Strait of *Magellan*, the Strait of *Gibraltar*, &c.

STRIKING-WHEEL, in a Clock, is that which by some is called the Pin-Wheel; because of the Pins which are placed upon the Round or Rim (which in Number are the Quotient of the Pinion, divided by the Pinion of the Detent-Wheel,) in 16 Days Clocks, the first or great Wheel is usually the Pin-Wheel; but in Pieces that go eight Days, the second Wheel is the Pin-Wheel, or striking Wheel.

STYLE, in Dialling, is that Line whose Shadow on the Plane of the Dial shews the true Hour-Line. This is always supposed to be a Part of the Axis of the Earth, and therefore must always be so placed, as that with its two extreme Points it shall respect the two Poles of the World, and with its upper End, the elevated Pole. This Line is the upper Edge of the Cock, Gnomon, or Index.

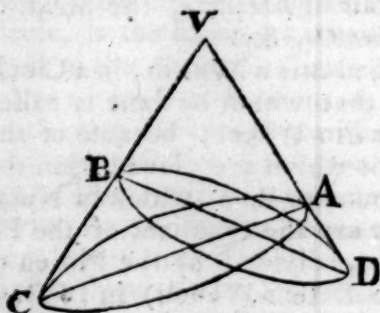
STYLOBATA, in Architecture, is the Pedestal of a Column or Pillar.

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STYLOBATION, or *Stylobata*, in Architecture, is the same with the Pedestal of a Column. This is sometimes taken for the Trunk of the Pedestal, between the Cornice and the Base; and then called Truncus, as it is also by the Name of Abacus.

SUBCONTRARY POSITION, in Geometry, is when two similar Triangles are so placed as to have one common Angle V at the Vertex, and yet their Bases are not parallel.

And therefore if the Scaleneus Cone BVD be so cut by the Plane CA , as that Angle $C = D$, the



Cone is then said to be cut subcontrarily to its Base BD ; and the Section CA of a Cone thus cut is a Circle.

SUBDUCTION, the same with *Substraction*; which see.

SUBDUPLERATIO, is when any Number or Quantity is contained in another twice: Thus 3 is said to be Subduple of 6, as 6 is double of 3.

SUBDUPLICATE RATIO of any two Quantities, is the Ratio of their Square Roots.

SUBLUNARY, are all Things that are in the Earth, or in the Atmosphere thereof, below the Moon.

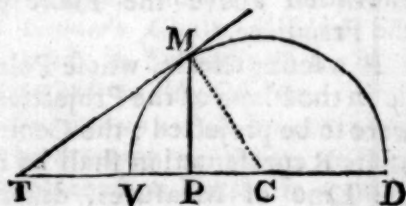
SUBMULTIPLE NUMBER, or Quantity, is that which is con-

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tained in another Number, a certain Number of Times exactly: Thus, 3 is Submultiple of 21, as being contained in it 7 Times exactly.

SUBMULTIPLE PROPORTION, the Reverse of Multiple. Which see.

SUBNORMAL, is a Line, as PC , determining in any Curve the Intersection of the Perpendicular to the Tangent in the Point



of Contact, with the Axis. And this Subnormal in the common or Apollonian Parabola, is a determinate invariable Quantity; for 'tis always equal to half the Parameter of the Axis.

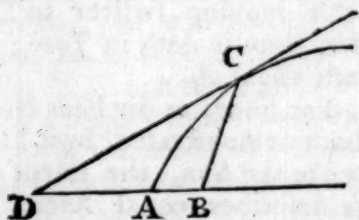
SUBSTITUTION, in Algebra, or Fluxions, is the putting in the Room of any Quantity in an Equation some other Quantity which is really equal to it, but expressed after another manner.

SUBTANGENT, in a Curve, is a Line as TP , which determines the Intersection of the Tangent in the Axis; and in any Equation if the Value of the Subtangent comes out positive, 'tis a sign that the Point of Intersection of the Tangent and Axis falls on that Side of the Ordinate, where the Vertex of the Curve lies; as in the Parabola and Paraboloids: But if it comes out negative, the Point of Intersection will fall on the contrary Side of the Ordinate, in respect of the Vertex or Beginning of the Abscissa; as in

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in the Hyperbola and Hyperboliform Figures. And universally in all Paraboliform and Hyperboliform Figures, the Subtangent is equal to the Exponent of the Power of the Ordinate multiplied into the Abscissa.

If CB be an Ordinate to AB in any given Angle terminating in any Curve AC , and $AB=x$,



$BC=y$, and the Relation between x and y , that is, the Nature of the Curve, be expressed by this Equation, $x^3-2xxy+bx^2-bbx+byy-y^3=0$, then this will be the Rule of drawing a Tangent to it: Multiply the Terms of the Progression by any Arithmetical Progression; according to the Dimensions of y , suppose $x^3-2xxy+bx^2-bbx+byy-y^3$; as

0 1 0 0 2 3
also according to the Dimensions of x , as,

$$\begin{matrix} x^3 & - & 2xxy & + & bx^2 & - & bbx & + & byy & - & y^3 \\ 3 & & 2 & & 2 & & 1 & & 0 & & 0 \end{matrix}$$

the former Product shall be the Numerator, and the latter divided by x , the Denominator of a Fraction expressing the Length of the Subtangent BD , which in this Case will be

$$= \frac{-2xxy+2byy-3y^3}{3xx-4xy+2bx-bb},$$

SUBSTYLAR LINE, in Dialling, is that Line drawn on the Plane of the Dial, over which the Style stands at Right-Angles with the

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Plane. This is always the Representation of the Meridian of that Place, where the Plane of the Dial is Horizontal. The Angle between this Line and the true Meridian, is the Plane's Difference of Longitude, and is measured on the Equinoctial.

SUB SUPER PARTICULAR PROPORTION, is contrary to *Super Particular Proportion*. Which see.

SUBTENCE, or *Chord of an Arch*, is a Right Line extended from one End of that Arch to the other End thereof.

SUBTRACTION, ingeneral, is taking a lesser Quantity from a greater, to find the Difference between them, which is commonly called the Remainder, as the lesser Quantity to be subtracted is called the Subtrahend.

The general Sign or Mark of Subtraction is —

SUBTRIPLE RATIO, is when any one Number or Quantity is contained in another three times. Thus 2 is said to be subtriple of 6, as 6 is the Triple of 2.

SUBTRIPPLICATE RATIO, is the Ratio of the Cube-Roots.

SUCCESSION of Signs, is that Order in which they are usually reckon'd: As, first, *Aries*, next *Taurus*, then *Gemini*, &c. This is otherwise called Consequence.

SUCULA, or *Succula*, is a Term in Mechanicks for a Bare Axis or Cylinder, with Staves in it to move it round, but without any Tympanum or Peritrochium.

SUN. Our excellent Sir *Isaac Newton*, saith in his *Principia*, that the Density of the Sun's Light (which is proportional to his Heat) is seven times as great at *Mercury*, as with us; and therefore

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our Water there would be all carried off, and boil away: For he found by Experiments of the Thermometer, that an Heat but seven times as great as that of the Sun-Beams in Summer, will serve to make Water boil.

1. He proves also, that the Matter of the Sun to that of *Jupiter* is nearly as 1100 to 1; and that the Distance of that Planet from the Sun, is in the same Ratio as the Sun's Semidiameter.

2. That the Matter of the Sun to that of *Saturn*, is as 2360 to 1; and the Distance of *Saturn* from the Sun is in a Ratio but little less than that of the Sun's Semidiameter: And consequently, that the common Centre of Gravity of the Sun and *Jupiter* is nearly in the Superficies of the Sun; of *Saturn*, and the Sun a little within it.

3. And by the same Manner of Calculation it will be found, that the common Centre of Gravity of all the Planets, cannot be more than the Length of the Solar Diameter distant from the Centre of the Sun: This common Centre of Gravity he proves to be at rest; and therefore tho' the Sun, by reason of the various Position of the Planets, may be moved every way, yet it cannot recede far from the common Centre of Gravity, and this, he thinks, ought to be accounted the Centre of our World. *Book 3. Prop 12.*

4. By means of the Solar Spots it hath been discovered, that the Sun revolves round its own Axis, without moving (considerably) out of his Place, in about twenty five Days, and that the Axis of this Motion is inclined to the Ecliptick in an Angle of 87 De-

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grees 30 Minutes nearly; the Sun's apparent Diameter being sensibly shorter in *December* than in *June*, as is plain, and agreed from Observation, the Sun must be proportionable nearly to the Earth in Winter than in Summer; in the former of which Seasons will be the Perhelion, in the latter the Aphelion: And this is also confirmed by the Earth's moving swifter in *December*, than it doth in *June*; as it doth about $\frac{2}{3}$.

5. For since, as Sir *Isaac Newton* hath demonstrated, by a Line drawn to the Sun, the Earth always describes equal Areas in equal Times, whenever it moves swifter, it must needs be nearer to the Sun: And for this Reason there are about eight Days more from the Sun's Vernal Equinox to the Autumnal, than from the Autumnal to the Vernal.

According to Mr. *Cassini*, the Sun's greatest Distance from the Earth is 22374, his mean Distance 2200, and his least Distance 8022 Semidiameters of the Earth.

7. The Sun's Diameter is equal to an hundred Diameters of the Earth; and therefore the Body of the Sun must be 1000000 times greater than that of the Earth.

Mr. *Azout* assures us, that he observed by a very exact Method the Sun's Diameter to be no less than 21 Minutes 45 Seconds in his Apogee, and not greater than 32 Minutes 45 Seconds in his Perigee.

9. The mean apparent Diameter of the Sun, according to Sir *Isaac Newton*, is 32 Minutes 12 Seconds, in his Theory of the Moon,

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10. If you divide 360 Degrees (*i. e.* the whole Ecliptick) by the Quantity of the Solar Year, it will quote 59 Minutes 8 Seconds, &c. which therefore is the Quantity of the Sun's Diurnal Motion; and if this 59 Minutes 8 Seconds be divided by 24, you have the Sun's Horary Motion, which is 2 Minutes 28 Seconds; and if you will divide this last by 60, you will have his Motion in a Minute, &c. And this Way are the Tables of the Sun's mean Motion, which you have in the Books of Astronomical Calculation, constructed.

11. The Sun's Horizontal Parallax, Dr. Gregory and Sir Isaac Newton make but 10 Seconds.

SUNDAY LETTER, the same with Dominical Letter.

SUPERFICIAL NUMBERS, the same with Plain Numbers:

SUPERFICIES, the same with Surface, (which see,) is Length and Breath only, without Thickness.

The Notion of a Line's being made up of an infinite Number of equidistant Points; of a Superficies, of an infinite Number of equidistant Lines; and of a Solid's, of an infinite Number of equidistant Surfaces or Superficies, is false, and will lead a Person into a Multitude of Absurdities in the Investigation of Proportions of the Surfaces of Bodies, &c. For if a Pyramid or Cone be conceived, the one as made up of an infinite Number of equidistant Squares, and the other as made up of an infinite Number of equidistant Circles parallel to their respective Bases, continually increasing as the Squares of the Natural Numbers, it will from thence follow, that the Sur-

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faces of any two Pyramids or Cones of the same Base and Altitude will be equal, which every one knows is false: And the Reason why from this Notion a true Conclusion is sometimes drawn, when the Proportions of Plain Surfaces, or of Solids, contain'd between the same Parallels, is sought, is because the infinite Number of Parallelograms of which a Plain Figure may consist, and the infinitely small Parallelepipedons, of which a Solid does, when their Proportions are sought, are all of the same infinitely small Height, and so they are to each other as their Bases; whence these Bases, in this Case, may be taken for the Correspondent Parallelograms or Parallelepipedons, and so no Error will arise.

SUPERPARTICULAR PROPORTION, is when one Number or Quantity contains another once, and one such Part whose Numerator is 1; then the Number so contained in the greater, is said to be to it in superparticular Proportion.

SUPERPARTIENT PROPORTION, is when one Number or Quantity contains another once, and some Number of aliquot Parts remaining; as,

$$1 \frac{2}{3}, 1 \frac{3}{4}, 1 \frac{4}{5}, \&c.$$

SUPPLEMENT of an Arch, in Geometry or Trigonometry, is the Number of Degrees that it wants of being an entire Semi-Circle; as the Complement signifies what an Arch wants of being a Quadrant.

SURD ROOTS, or Numbers.

1. When any Number or Quantity hath its Root proposed to be extracted, and yet is not a true

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true figurate Number of that kind, that is, if its Square Root being demanded, it is not a true Cube, &c. then 'tis impossible to assign, either in whole Numbers or Fractions, any exact Root of such a Number proposed; and whenever this happens, 'tis usually, in Mathematicks, to mark the required Root of such Numbers or Quantities, by prefixing before it the proper Marks of Radicality, $\sqrt{}$. Thus, $\sqrt{}: 2$ signifies the Square Root of 2. and $\sqrt[2]{}: 16$. or $\sqrt{}: (3) 16$. signifies the Cubical Root of 16; which Roots, because they are impossible to be expressed in Numbers exactly, (for no Number, either Integer or Fraction, multiplied into itself, can ever produce 2, or $\frac{1}{2}$ Sing multiplied Cubically, can ever produce 16,) are very properly called *Surd Roots*.

2. There is also another Way of Notation, now much in use, whereby Roots are expressed, without the Radical Sign, by their Indexes: Thus, as x^2 . x^3 . x^5 . &c. signify the Square, Cube, and fifth Power of x ; so $x^{\frac{1}{2}}$. $x^{\frac{1}{3}}$. $x^{\frac{1}{4}}$. &c. signify the Square Root, Cube Root, &c. of x . The Reason of which is plain enough; for since $\sqrt{}: x$ is a Geometrical mean Proportional between 1 and x . so $\frac{1}{2}$ is an Arithmetical mean Proportion between 0 and 1, and therefore as 2 is the Index of the Square of x , $\frac{1}{2}$ will be the proper Index of its square Root, &c.

3. Observe also, that for Convenience or Brevity sake, Quantities or Numbers which are not Surds, are often expressed in the

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Form of Surd Roots: Thus;

$\sqrt{}: 4$, $\sqrt[2]{}: 2$, $\sqrt[3]{}: 27$, &c. signify, 2, $\frac{1}{2}$, 3, &c.

SURDS are either simple, which are expressed by one single Term, or else compound, which are formed by the Addition or Subtraction of simple Surds:

As, $\sqrt{}: 5 + \sqrt{}: 5 - \sqrt{}: 2$. or $\sqrt[3]{}: 7 + \sqrt{}: 2$. Which last is called, an Universal Root; and signifies the Cubick Root of that Number, which is the Result of adding 7 to the Square Root of 2.

SURFACE, (the same with Superficies) is the bare Outside of any Body; and considered by it self, is Quantity extended in Length and Breadth only, without Thickness.

SURSOLID LOCUS. See *Locus Surfolid*.

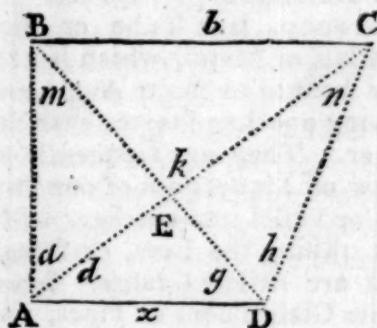
SURSOLID PROBLEM, in Mathematicks, is that which cannot be resolved, but by Curves of a higher Nature than a Conick Section, *v. gr.* in order to describe a Regular Endecagon, or Figure of eleven Sides in a Circle, 'tis required to describe an *Isoceles* Triangle on a Right Line given, whose Angles at the Base shall be quintuple to that at the Vertex; which may easily be done by the Intersection of a Quadratrix, or any other Curve of the second Gender, as they are called by some.

SURVEYING of Land, or *Planimetria*, is the Art of measuring all manner of Plain Figures, in order to know their superficial Content; which how to do Geometrically, I have shewn all along, under the particular Name

Name of each Plane Figure :
But how to bring this to Practice,
so as to measure the Areas of
Real Lands, Fields, Grounds,
&c. by the Help of proper In-
struments, is what we usually
call Surveying.

The following useful Problem
being uncommon, and the Solu-
tion easily following from the
Investigation, I thought it might
not be amiss to insert it.

The Side BC given, together
with the Angles BAC , CAD ,
 ADB , BDC , to find the Side
 AD . let us call the Side BC . (b),
the Angle BAC . (a), and the An-
gle CAD . (d), also BDA . (g), and
the Angle BDC . (h), and the An-



gle AED . (which is also given)
(k), and the Angles B , C , (m and
 n), and lastly the Side AD . (x)
then it will be as the Sine of the
Angle (k) is to (x) :: Sine (g) :

$\frac{gx}{k} = AE$. And as the Sine of the

Angle (k) is to (x), so is the Sine

of (d) to $\frac{xd}{k} = ED$. Also as

the Sine of (m) : $\frac{xg}{k}$ (AE) ::

so is the Sine of (a) : to

$\frac{xga}{mk} = BE$; and as the Sine of

(n) : $\frac{xd}{k} = (ED)$:: so is the Sine

of (b) to $\frac{xdb}{nk} = (EC)$. Now as

$BE + EC : EC - BE$:: so is the
Tangent of half the Sum of the
Angles BCE and CBE (which are
given) to the Tangent of half
their Difference : Therefore as

$\frac{x \times nag + mdb}{mnk} (BE + EC) :$

$\frac{x \times mdb - nag}{mnk} (EC - BE)$

so is the Tangent of half the Sum
of the Angles BCE , CBE , to the
Tangent of half their Difference.

But because $\frac{x}{mnk}$ is in both

Terms of the Ratio, it will be as
the Signs of $nag + mdb : mdb -$
 nag :: so is the Tangent of half
the Sum of the Angles to the
Tangent of half their Difference :
But because the Sines of (nag) and
(mdb) are all known, therefore
may the Angles BCE and CBE
be found, and consequently the
Sides CE and BE , as also AE
and ED , and thence the Side
 AD sought may be it self also
found. *Q. E. P.*

SWALLOWS-TAIL, in Fortifi-
cation, is a single T-naille, that
is narrower towards the Place
than towards the Country.

SURVEYING SCALE, the same
with Reducing Scale.

SUPERFICARAL FOURNEAU,
a Term in Fortification, the
same with Caïsson, which is a
wooden Chest, or Box, with
three, four, five, or six Bombs
in it; and sometimes 'tis filled
only with Powder, and is used
in a close Siege, by being buried
under Ground with a Train to
it, to blow up any Lodgment
that

that the Enemy shall approach to.

SWING-WHEEL, in a Royal Pendulum. This Wheel in a Watch is called the Crown Wheel, as also in a Balance Clock.

SYDERIAL YEAR. See *Year*.

SYMMETRY, in Architecture, comes from the Greek *Symmetria*, with Measure, and signifies the Relation of Parity, both as to Height, Depth, and Breadth, which the Parts have, in order to form a beautiful Whole. In Architecture we have both uniform Symmetry, and respective Symmetry: In the former, the Ordinance is pursued in the same manner throughout the whole Extent; whereas in the latter, only the opposite Sides correspond to each other.

SYNCOPIATION, a Term in Musick, which is when a Note of one Part ends and breaks off upon the Middle of a Note of another Part.

SYNCOPE, in Musick, is the Driving Note, when some shorter Note prefixed at the Beginning of the Measure, or half Measure, is followed by two, three, or more Notes of a greater Quantity, before you meet with another short Note equivalent to that which began the Driving, to make the Number even; as when an odd Crotchet comes before two, three, or more Minims, or an odd Quaver before two, three, or more Crotchets.

SYNODICAL MONTH, is the Space of Time (*viz.* 29 Days, 12 Hours, 45 Minutes) contain'd between the Moon's parting from the Sun at a Conjunction, and returning to him again; during

which Time she putson all her Phases. And her

SYNODICAL REVOLUTION, is that Motion whereby her whole System is carried along with the Earth round the Sun.

SYNTHETICAL METHOD of Enquiry, or *Demonstration*, in Mathematicks, is when we pursue the Truth, chiefly by Reasons drawn from Principles before established, and Propositions formerly proved, and proceed by a long regular Chain, till we come to the Conclusion; as is done in the Elements of *Euclid*, and in almost all the Demonstrations of the Ancients. This is called *Composition*, and is opposed to the Analytical Method, which is called *Resolution*. Which see.

SYPHON, is a Tube or Pipe of Glas or Metal, which is usually bent to an Acute Angle, and having one Leg shorter than the other. They are frequently to draw off Liquors out of one Barrel or Vessel into another, without raising the Lees, or Dregs, and are called Cranes. Sometimes Glas Tubes or Pipes, tho' strait, are called *Syphons*.

SYSTEM, in Musick, is the Extent of a certain Number of Chords, having its Bounds toward the Grave and Acute, which hath been differently determined by the different Progress made in Musick, and according to the different Divisions of the Monochord.

The System of the Ancients was composed of four Tetrachords, and one supernumerary Chord, the whole making fifteen Chords.

SYSTEM, properly is a regular orderly Collection, or orderly Disposition of all those Planets, which

which move round the Sun as their Centre, in determined Orbits, and never deviate farther from him than their proper and usual Bounds. And a

SYSTEM of *Philosophy*, is a regular Collection of the Principles and Parts of that Science into one Body, and a treating of them dogmatically, or in a scholastical Method; which is called the *Systematical Way*, in contradistinction of the Way of Essay, wherein the Writer delivers himself more loosely, easily and modestly.

SYSTILE, in Architecture, is that Manner of placing Columns where the Space between the two Fufts consists of two Diameters, or four Modules.

SYZYG, in Astronomy, is the same with the Conjunction of any two Planets or Stars, or when they are both referred to the same Point in the Heavens; or when they are referred to the same Degree of the Ecliptick, by a Circle of Longitude passing through them both.

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TAILIER: See *Abacus*.

TALON, a little Member in Architecture, consisting of a square Fillet, and a streight Cymatium, and is only two Portions of a Circle.

TALUS, in Architecture, is the same with *Astragalus*; which see: But in Fortification it signifies any Thing that goes sloping; or it is the *French Word* for a Slope.

TANGENT of a Curve, is a Right Line drawn so as to touch it, but if continued, will not cut it.

TAPER-BORED, a Term in Gunnery: A Piece of Ordnance is said to be Taper-Bored when it is wider at the Mouth than towards the Breech.

TELESCOPE, is a Dioptrick Instrument, composed of Lenses, by Means of which remote Objects, appear as if they were near.

It is certain that *Johanes Baptista Porta*, a Neapolitan, was the first that made a Telescope, about the Year 1594: For he says, in *Magis. Natur. lib. 17. c. 10. Si utrumque* (that is, a Concave and Convex Glass) *recte conjungere noveris, & longinqua & proxima majora, & clara videbis, non parum multis amicis auxilii prestitimus, qui & longinqua obsoleta, proxima turbida conspiciebant, ut omnia perfectissime contuerentur*. But *Porta* did not well understand his own Invention, which he had found out by Chance, and so had not effected it with any great Industry, or applied the same to Cœlestial Observations. Not long after him, there were several others that made short Telescopes; but they were of small Use, till *Gallileo* applied himself to the making of one, who was the first that made it tolerably good.

A Telescope, made by a Convex and concave Lens, represents vastly distant Objects, distinct and erect; and magnifies them according to the Proportion of the Focal Distance of the Convex Lens, to the Focal Distance of the Concave Lens.

A Telescope, made of two Convex Lenses, represents vastly distant Objects, distinct, but inverted; and magnifies them according to the Proportion of the Focal Distance of the Exterior, or Object

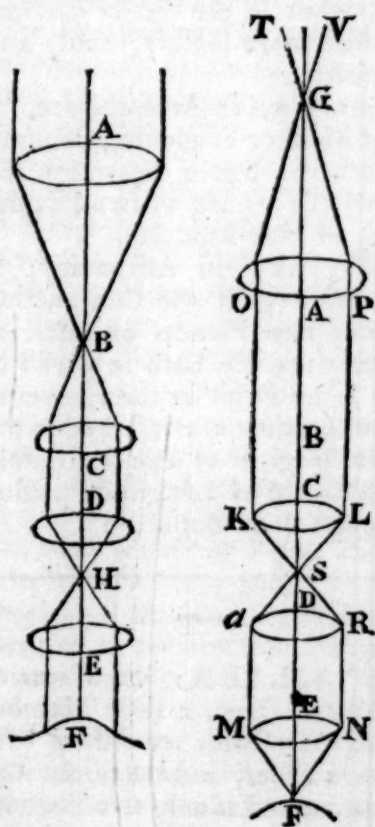
Object Lens, to the Focal Distance of the Interior or Ocular Lens,

The Explanation of the Construction of a Telescope compounded of four Convexes, by Means of which Objects are seen erect, and very ample.

Telescopes, made of two Convexes, because of their Inverting the Position of the Object, are seldom used, except in observing the Stars, the Position of which is not regarded. The Proportion in which this Sort magnifies the Object, has already been shewn; but if we would have these Images again made erect, and, at the same Time, a great Share of them be represented to the Eye, at one View, very ample, we must use three, four, five, or more Lenses; which, however, are not to be multiplied without Cause, because the Matter of each of them, and the Reflexion of their several Surfaces, divert Part of the Rays: But we cannot obtain the desired Effect perfectly, with fewer than four Lenses: For although, in the same Length of the Telescope, both an erect Situation, and the same Degree of magnifying, and an equal Share of the Object may be had as well with three as four Lenses, yet the Composition of three Lenses is much more convenient than that of four; because in that, the two Ocular Lenses, or, at least, that which is next the Eye, must be made of larger Segments of a Sphere, with respect to its Diameter, or to the Focal Distance, if the same Magnitude of the Visual Angle be required: And hence the Objects come to be Coloured; and Right Lines, at

the Margins of the Aperture appear Curve: Therefore we must make our Telescope of four Lenses, which is done after the following Manner.

The Exterior, or Object Lens, is *A*, whose Focal Distance is *AB*, and in the same Axis are placed three Ocular Lenses, *C, D*, and *E*, all equal to one another, the inmost of which is placed beyond the Focus *B*, by its Focal



Distance *BC*; and the next *D*, is placed beyond *C*, by twice that Distance *BC*, and the last as far from *D* as that was from *C*; and lastly, the Eye must be placed beyond this last by the Distance *BC*.

There is here again Occasion for two Figures; in the first of which are represented Rays proceeding

ceeding from a single Point of the vastly distant Object; which, 'tis plain to any who understand what has gone before: First, fall, as it were, parallel upon the Lens *A*, and are by it collected at its Focus *B*; and thence diverging, fall upon the Lens *C*, which makes them again parallel, and throws them upon the Lens *D*, which collects them at its Focus *H*, the middle Point of the Distance *DE*; from whence proceeding on to the Lens *E*, they are by it made a third Time parallel; and being received so by the Eye *F*, they make distinct Vision by being collected at its Focus which is in the Bottom of the Eye.

The other Figure considers the Proportion of magnifying, which is that which *AB*, the Focal Distance of the Object Lens, bears to *BC*, the Focal Distance of one of the Ocular Lenses, and demonstrates likewise the Amplitude of the Visual Angle; for the Apertures of the three Ocular Lenses, being supposed equal, which must not exceed the Apertures of the Object Lens *A*, draw *ME*, *NR*, parallel to the common Axis; and comprehending the Diameters of the Apertures of the Lenses *E* and *D*, and also *KO*, *LP*, parallel to the same Axis, and comprehending *KL* the Aperture of the Lens *C*; and taking *AG*, equal to *AB*, draw the Lines *OGV*, *PGT*, intersecting one another in *G*. Now, it is evident the Latitude of the Object which is seen by the naked Eye from the Point *G*, and consequently from *F* also, the Distance of the Object being as it were infinite, would appear comprehended in the Angle *MFN*; and conse-

quently the Proportion of the apparent Magnitude to the true, is as the Angle *MFN* to the Angle *TGV* or *PGO*; that is, *PO* and *MN* being equal, as the Distance *AG*, to the Distance *FF*; that is, as *AB*, the Focal Distance of one of the Ocular Lenses, *Q.E.D.*

It appears, moreover, that the Visual Angle *MFN*, comprehends the same Latitude of the Object, with a Telescope made of two Lenses, only *A* and *C*; for that Share of the Object which is comprehended in the Angle *TGV*, would be seen through that Telescope in the Angles *KSL*, equal to the Angles *MFN*.

This incomparable Composition of Lenses, was found out by I know not whom at *Rome*; and may be much improved by placing an Anuculus or Ring either at *H*, the common Focus of the Lenses *D* and *E*, or at *B*, the common Focus of the Lenses *A* and *C*; which is especially of very great Use in measuring the Diameters of Planets: For this Anuculus does therefore exactly circumscribe the Circle of the apparent Images, because it cuts off those irregular Rays which are not collected near enough to *B* or *H*, and consequently are not, by Means of the succeeding Lenses, sent parallel to the Eye, which distinct Vision requires; and the Colours likewise near the Margins are by this Contrivance taken away, which without it are not well to be avoided. The Proportions between the Focal Distance of the Object Lens, (which is likewise the Length of the Telescope,) the Aperture of the same Object Lens, the Focal Distance of the

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Ocular Lens, and the Apparent Magnified Diameter of the Object ; for Telescopes, from the

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Length of one Rhinland Foot to a Hundred, are expressed in the Table following.

A Table for TELESCOPES.

| <i>The Focal Distance of the Object Lens, or the Length of the Telescope.</i> | <i>The Diameter of the Aperture of the Object Lens.</i> | <i>The Focal Distance of the Ocular Lens.</i> | <i>The Proportion of magnifying considered as to the Diameter.</i> |
|---|---|---|--|
| <i>Rhinland Feet.</i> | <i>Inches and Decimals.</i> | <i>Inches and Decimals.</i> | |
| 1. | 0,55. | 0,61. | 20. |
| 2. | 0,75. | 0,85. | 28. |
| 3. | 0,95. | 1,05. | 34. |
| 4. | 1,09. | 1,20. | 40. |
| 5. | 1,23. | 1,35. | 44. |
| 6. | 1,34. | 1,47. | 49. |
| 7. | 1,45. | 1,60. | 53. |
| 8. | 1,55. | 1,71. | 56. |
| 9. | 1,64. | 1,80. | 60. |
| 10. | 1,73. | 1,90. | 63. |
| 13. | 1,97. | 2,17. | 72. |
| 15. | 2,12. | 2,33. | 77. |
| 20. | 2,45. | 2,70. | 89. |
| 25. | 2,74. | 3,01. | 100. |
| 30. | 3,00. | 3,30. | 109. |
| 35. | 3,24. | 3,56. | 118. |
| 45. | 3,46. | 3,81. | 126. |
| 40. | 3,67. | 0,04. | 133. |
| 50. | 3,87. | 4,26. | 141. |
| 55. | 4,06. | 4,47. | 148. |
| 60. | 4,24. | 4,66. | 154. |
| 65. | 4,42. | 4,86. | 161. |
| 70. | 4,58. | 5,04. | 166. |
| 75. | 4,74. | 5,21. | 172. |
| 80. | 4,90. | 5,39. | 178. |
| 85. | 5,05. | 5,56. | 183. |
| 90. | 5,20. | 5,72. | 189. |
| 95. | 5,34. | 5,87. | 194. |
| 100. | 5,48. | 6,03. | 199. |

T E

Sir *Isaac Newton*, in his *Opticks*, says, if the Theory of making of Telescopes could, at length, be fully brought into Practice, yet there would be certain Bounds, beyond which Telescopes could not perform: For the Air through which we look upon the Stars, is in perpetual Tremor, as may be seen by the tremulous Motion of Shadows cast from high Towers, and by the twinkling of the fix'd Stars. But these Stars do not twinkle when viewed through Telescopes which have large Apertures; for the Rays of Light, which pass through divers Parts of the Aperture, tremble each of them apart; and, by Means of their various, and sometimes contrary Tremors, fall at one and the same Time upon different Points in the Bottom of the Eye, and their trembling Motions are too quick and confus'd to be perceiv'd severally: And all these illuminated Points constitute one broad lucid Point, composed of those many trembling Points, confusedly and insensibly mix'd with one another by very short and swift Tremors, and thereby cause the Star to appear broader than it is, and without any trembling of the Whole. Long Telescopes may cause Objects to appear brighter and larger than short ones can do; but they cannot be so formed as to take away that Confusion of the Rays which arises from the Tremors of the Atmosphere. The only Remedy is a most serene and quiet Air, such as may perhaps be found on the Tops of the highest Mountains above the grosser Clouds.

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TELESCOPE (ÆRIAL,) is one of Mr. *Hugen's*, describ'd in the *Philosophical Transactions*, pag. 161. made for using only in the Night; and so having no Close Tube, since there is no need of one in the Night.

TELESCOPE (REFLECTING,) consists of a Large Tube, open at one End, being that next to the Object, and having the other End close, where a Concave Metalline Speculum is placed; and having near the open End a flat Oval Speculum inclined towards the upper Part of the Tube, where is a little Hole furnished with a small plane Convex Eye-Glass. There is a full Account of this Instrument by Sir *Isaac Newton*, in the *Philosophical Transactions*, num. 81. and in num. 376. Mr. *Hadley* has given us a Description of an Instrument of this Kind of five Feet one Fourth in Length; which, used as a Night Telescope, will magnify about two hundred and twenty Times, and, as a Day one, about one hundred twenty-five Times; and is in several Respects superior, and in none inferior to Mr. *Hugen's* Dioptrick Telescope of one hundred and twenty-six Feet in Length.

TELESCOPICAL STARS, are those that are not visible to the naked Eye, but discoverable only by the Help of a Telescope.

TEMPERATE ZONE: See *Zone*.

TEMPERARY FORTIFICATION: See *Fortification*.

TENAILLE, in Fortification, is a Kind of Out-Work resembling a Horn-Work, but generally somewhat different; in regard that instead of two Demi-Bastions, it bears only in Front a Re-entring Angle between the

B b 2 same

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same Wings without Flanks, and the Sides are parallel : But when there is more Breadth at the Head than at the Gorge, these Tenaïles are called *Queue d'yrondes*. All Tenaïles are defective in this Respect, that they are not flanked or defended towards their inward or dead Angle, because the Height of the Parapet hinders seeing down before the Angle ; so that the Enemy can lodge himself there under Covert : Wherefore Tenaïles are never made, but when they want Time to make Horn-Works.

TENOR, is the Name of the first Mean or middle Part in Musick.

TERM, in Geometry, is taken for the Bounds and Limits of any Thing.

TERMS of an Equation, in Algebra, are the several Names or Members of which it is composed, and such as have the same unknown Letter, but in different Powers or Degrees : For if the same unknown Letter be found in several Members in the same Degree or Power, they shall pass but for one Term.

As, in this Equation, $xx + ax = bb$; the three Terms are xx , ax , and bb . Moreover in this, $x^4 + x^3 + x^2 + \frac{ab}{cd}x + \frac{fp}{rs}x + yy =$ 0 ; the Terms are x^4 , x^3 , x^2 , $\frac{ab}{cd} + \frac{fp}{rs} \times x$, and yy where $\frac{ab}{rs}x$, and $\frac{fp}{rs}x$, are the same Terms ; and the first Term in any Equation must be that where the unknown Root hath the highest Dimensions ; and that Term which hath the Root in it, of one Dimension of

T E

Power lower, is called the second Term, and so on.

TERMS of Proportion, in Mathematicks, are such Numbers, Letters, or Quantities, as are compared one with another.

Thus if $2.4 :: c. d$, then a, b, c, d , or 2, 4, 8, 16. are called the Terms ; A being the first Term, b the second Term, &c.

TERRAQUEOUS, in Geography, signifies the Globe of Earth and Water, as they both together constitute one Spherical Body.

TERRE (PLAIN), in Fortification, is the Platform or Horizontal Surface of the Rampart lying level, only with a little Slop on the Outside for the Recoil of the Cannon.

It is terminated by the Parapet on that Side toward the Field, and by the Inner Talus on the other toward the Body of the Place.

TERRELLA : When a Loadstone is made Spherical, and is placed so that its Poles and Equator, &c. do exactly correspond to the Poles and Equator of the World, it is called by Gilbert a *Terrella*, or little Earth ; being in some Measure a Representation of our great Globe of Earth.

TERRESTRIAL GLOBE : See *Globe*.

TERRESTRIAL LINE : See *Line Terrestrial*.

TETRACHORD, in Musick, is a Concord or Interval of three Tones,

The Tetrachord of the Ancients, was a Rank of four Strings, accounting the Tetrachord for one Tone, as it is often taken in Musick.

T E

TETRA DIAPASON. A Quadruple Diapason is a Musical Chord, otherwise called a Quadruple Eighth, or Nine and twentieth.

TETRAGONIAS, a Comet, whose Head is of a Quadrangular Figure, and its Tail or Train long, thick, and uniform; and does not differ much from the Meteor called *Trabs*.

TETRAHEDRON, is one of the Regular Bodies, consisting of four equal Equilateral Triangles; or it is a Triangular Pyramid of four equal Faces,

TETRASTYLE, in Architecture, is a Building which hath four Columns in the Faces before and behind.

TEXTURE. The Texture of any Natural Body, is that particular Disposition of its Constituent Particles; and making it have such Form, or be of such a Nature, or be endow'd with such Qualities.

THEODOLITE, is an Instrument used in Surveying, and taking of Heights and Distances.

And consisteth of several Parts; as a Circle of Brass, about one Foot Diameter, divided into four Quadrants, sometimes with a Telescope at the Bottom of it.

Each of the Quadrants is divided into ninety Degrees, and subdivided as the Largeness of the Instrument will permit.

A Box and Needle contrived to stand upon the Centre of the Circle, upon which Centre, the Instrument, the Index, with its Sights, and sometimes a Telescope, is made to turn about; and yet, both the Instrument, and the Box and Needle, remain firm. At the Bottom of the Box, there

T E

is a Card or Mariner's Compass fix'd.

A Socket on the Backside, to be put upon the Head of a three-legged Staff.

A Staff to set the Instrument upon; the Neck, at the Head whereof, must be made to go into the Socket on the Backside of the Instrument.

N. B. I must do Mr. *Thomas Heath* (Mathematical Instrument Maker, next Door to the *Fountain-Tavern* in the *Strand*,) the Justice to say, that I have seen excellent Theodolites made by him, as well as all other Mathematical Instruments.

THEOREM, is a speculative Proposition, demonstrating the Properties of any Subject.

THERMOSCOPE, is an Instrument shewing the Increase and Decrease of Heat and Cold in the Air: But the

THERMOMETER, is an Instrument by which we can measure the Heat and Cold of the Air.

It is usually made of a Tube of Glass of about four Foot long, filled with tinged Spirit of Wine, or some other proper Liquor, having a Ball at the Bottom of it.

THREE-LEGGED STAFF, is an Instrument consisting of three wooden Leggs, made with Joints to shut all together, and to take off in the Middle, for the better Carriage; and on its Top is usually a Ball and Socket to support and adjust Instruments for Astronomy, Surveying, &c.

TIDE. Tide signifies as well the Ebbing as the Flowing of the Sea; the former of which the Seamen call Tide of Ebb; the latter, Tide of Flood.

T E

In a Lunar Day, that is, the Time spent between the Moon's Going from the Meridian, and Coming to it again, the Sea is twice elevated, and twice depressed, in any assigned Place.

In any Place the Water is most elevated, two or three Hours after the Moon has pass'd the Meridian of the Place, or the opposite Meridian.

The Elevation towards the Moon a little exceeds the opposite one. The Ascent of the Water is diminished as you go towards the Poles, because there is no Agitation of the Water there.

From the Action of the Sun, every natural Day the Sea is twice elevated, and twice depressed. This Agitation is much less, on Account of the immense Distance of the Sun, than that which depends upon the Moon; yet it is subject to the same Laws.

The Motions which depend upon the Action of the Moon and Sun, are not distinguished but confounded; and from the Action of the Sun, the Lunar Tide is only changed; which Change varies every Day, by Reason of the Inequality between the Natural and Lunar Day.

In the Syzygies the Elevations from the Action of both Luminaries concur, and the Sea is more elevated; the Sea ascends less in the Quadratures; for where the Water is elevated by the Action of the Moon, it is depressed by the Action of the Sun, and so on the contrary. Therefore, whilst the Moon passes from the Syzygy to the Quadrature, the daily Elevations are continually diminished: On the contrary, they are increased when

T E

the Moon moves from the Quadrature to the Syzygy. At a new Moon also, *Ceteris paribus*, the Elevations are greater, and those that follow one another the same Day, are more different than at Full Moon.

The greatest and least Elevations are not observ'd, till the second or third Day after the New or Full Moon, if we consider the Luminaries receding from the Plane of the Equator, we shall perceive that the Agitation is diminished, and become less, according as the Declination of the Luminaries becomes greater.

In the Syzygies near the *Æquinoxes*, the Tides are observed to be the greatest, both Luminaries being in or near the Equator.

The Actions of the Moon and Sun are greater, the less those Bodies are distant from the Earth; but when the Distance of the Sun is less, and it is in the South Signs, often both the greatest *Æquinoctial* Tides are observed in that Situation of the Sun, that is, before the Vernal, and after the Autumnal *Æquinox*; which yet does not happen every Year, because some Variation may arise from the Situation of the Moon's Orbit, and the Distance of the Syzygy from the *Æquinox*. In Places distant from the *Æquator*, the Elevations that happen the same Day are unequal.

As long as the Moon is on the same Side of the Equator in any Place, the Elevation of the Water is observed to be the greatest every Day, after the Moon has passed the Meridian of the Place.

But if the Equator separates, or is between the Moon and the Place

lace of which we speak, the Water will come to the greatest Height; and every Day the greatest Elevation of the Sea will be, after the Moon has passed thro' the opposite Meridian.

All Things which have been hitherto explained would exactly obtain, if the whole Surface of the Earth was covered with Sea; but since the Sea is not every where, some Changes arise from thence; not indeed in the open Sea, because the Ocean is extended enough to be subject to the Motions we have spoken of. But the Situation of the Shores, the Streights, and many other Things depending upon the particular Situation of the Places, disturb these general Rules: Yet it is plain from the most general Observations, that the Tide follows the Laws which we have laid down.

The mean Force of the Sun to move the Sea, is to the mean Force of the Moon to move the same, as 1 to 4, 4815.

The Action of the Sun changes the Height of the Sea two Feet; and that the Action of the Moon changes it 8, 95: And that, from the joined Action of both, the mean Agitation is of about eleven Feet, which agrees pretty well with Observations; for, in the open Ocean, as the Sea is more or less open, the Water is raised to the Height of six, nine, twelve, or fifteen Feet; in which Elevations, also there is a Difference arising from the Depth of the Waters; but those Elevations, which far exceed these, happen where the Sea violently enters into the Streights or Gulphs, where the Force is not broken till the Water arises higher.

TIME, in Musick, is that Quantity or Length whereby is assigned to every particular Note its due Measure, without making it either longer or shorter than it ought to be; and it is twofold, viz. Duple or Common, and Triple.

TIME (DUPLE,) or *Semi-breve*, generally called *Common*, because most used, is when all the Notes are encreased by two.

TIME (TRIPLE,) is that wherein the Measure is counted by Threes.

TIME, is a Succession of Phenomena, and the Idea that we have thereof, consists in the Order of successive Préceptions: It is divided into Absolute and Relative.

TIME (*Astronomical, Mathematical, or Absolute*,) flows equably in it self, without relation to any Thing external; and, by another Word, is called *Duration*. But,

TIME (*Relative, Apparent, or Vulgar*,) is the sensible and external Measure of any Duration estimated by Motion; and this the Vulgar use instead of true Time.

TONDINO, a Term in Architecture: See *Asragal*.

TONS, a Term in Musick, signifying a certain Degree of Elevation or Depression of the Voice, or some other Sound.

TOPOGRAPHY, is a particular Description of some small Quantity of Land, such as that of a Manor, or particular Estate, &c.

TORID ZONE. See *Zone*.

TORUS, in Architecture, is a large round Moulding in the Bases of the Columns.

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TRABEATION, the same with *Entablement*.

TRAJECTORY of a *Comet*, is the Line which, by its Motion, it describes.

TRANSCENDENTAL CURVES, are such as when their Nature or Property is express'd by an Equation, one of the variable Quantities therein, denotes a Curve Line; and when such Curve Line is a Geometrick one, or one of the first Degree or Kind, then the Transcendental Curve is said to be of the second Degree or Kind, &c.

TRANSIT, in Astronomy, signifies the Passing of any Planet just by or under any fix'd Star; or of the Moon, in particular, covering or moving close by any other Planet.

TRANSITION, in Musick, is when a greater Note is broken into a lesser, to make smooth or sweeten the Roughness of a Leap by a gradual Transition, or passing to the Note next following; whence it is commonly called the Breaking of a Note, being sometimes very necessary in Musical Composition.

TRANSMUTATION, in Geometry, is to reduce or change one Figure or Body into another of the same Area or Solidity, but of a different Figure, as a Triangle into a Square, a Pyramid into a Parallelopiped, &c.

TRANSPARENT, or *Diaphanous Bodies*, are such as may be seen through.

TRANSPOSITION, in Algebra, is to bring any Term of an Equation over to the other Side, as if $a + b = c$; and you make $a = c - b$, then is b transposed.

TRANSVERSE AXIS, or *Diameter of an Ellipsis*, is the longer Axis.

T R

TRAPEZIUM, in Geometry, is a Plane Figure contained under four unequal Right Lines.

TRAPEZOID, is a solid irregular Figure, having four Sides not parallel to one another.

TRAVERSE, a Term in Gunnery, signifying to turn a Piece of Ordnance which Way one pleases upon her Platform.

Also the laying and removing a Piece of Ordnance, or a great Gun, in order to bring it to bear or lie level with the Mark, is called Traversing the Piece.

TRAVERSE, in Navigation, is the Variation or Alteration of the Ship's Course upon the shifting of Winds, &c.

TRAVERSE, in Fortification, is a little Trench bordered, with two Parapets, viz. one on the Right Side, and the other on the Left, which the Besiegers make quite thwart the Moat of the Place, to pass secure from Flank-Shot, and to bring the Miners to the Bastions.

TREBLE, is the last or highest of the four Parts in Musical Proportion.

TRENCHES, in Fortification, are certain Moats or Ditches, which the Besiegers cut to approach more securely to the Place attacked, and are of several Sorts, according to the different Nature of the Soil; for if the adjacent Territory be rocky, the Trench is only an Elevation of Bavins, Gabions, Wool-Packs, or Shouldrings of Earth, cast up round about the Place: But where the Ground may be easily opened, the Trench is dug therein, and bordered with a Parapet on the Side of the Besieged. The Breadth of it ought to be from

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from 8 to 10 Foot, and the Depth from 6 to 7.

These Trenches are to be carried on with winding Lines, in some Manner parallel to the Works of the Fortrefs, so as not to be in View of the Enemy, not to expose its Length to their Shot, which they call Enfilading, for then it will be in Danger of being enfiladed or scoured by the Enemies Cannon; and this carrying of the Trenches obliquely, they call, carrying the Trenches by Coudees or Tra-verses.

TRIANGLE, in Geometry, is a Figure of three Sides and three Angles; and is either a Plane Triangle, or a Spherical one.

A *Plane Triangle*, is contained under three Right Lines.

A *Spherical Triangle*, is contain'd under three Arches of a great Circle of the Sphere.

Of Triangles there are several Sorts, as,

1. A *Right-angled Triangle*, is that which hath one Right Angle.

2. An *Obtuse-angled Triangle*, is such as hath one Obtuse Angle.

3. An *Acute-Angled Triangle*, is that which hath all its Angles Acute.

4. Any *Triangle* that is not right-angled, is called *Oblique Angled*, or *Amblygonial*.

5. An *Equilateral Triangle*, is that which hath all its Sides equal to one another.

6. An *Isoceles*, or an *Equilegged Triangle*, is that which hath only two Sides equal.

7. A *Scalenous Triangle*, is that which has no two Sides equal.

1. In every Triangle, the Sum of all the three Angles is equal to two Right ones; and the External Angle made by any Side

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produced, is equal to the Sum of the Internal and its Opposite one.

2. In every Triangle, as well Plane as Spherical, the Sines of the Sides, are proportional to the Sines of the opposite Angles.

3. In every Plane Triangle, as the Sum of two Sides is to their Difference, so is the Tangent of half the Sum of the Opposite Angles, to the Tangent of half their Difference.

4. If a Perpendicular be let fall upon the Base of an Oblique-angled Triangle, the Difference of the Squares of the Sides is equal to the Double Rectangle under the Base, and the Distance of the Perpendicular from the Middle of the Base.

5. The Side of an Equilateral Triangle, inscrib'd in a Circle, is in Power triple of the Radius.

6. The Sides of a Triangle are cut proportionably, by a Line drawn parallel to the Base.

7. A whole Triangle, is to a Triangle cut off by a Right Line, as the Rectangle under the cut Sides, is to the Rectangle of the two other Sides.

8. In a Right-angled Triangle, a Line drawn from the Right Angle at the Top, perpendicular to the Hypothenuse, divides the Triangle into two other Right-angled Triangles, the which are similar to the first Triangle, and to one another.

9. In every Right-angled Triangle, the Square of the Hypothenuse is equal to the Sum of the Squares of the other two Sides.

10. If any Angle of a Triangle be bisected, the Bisecting Line will divide the opposite Side in the same Proportion as the Legs
of

of the Angle are to one another.

12. If the Vertical Angle of any Triangle be bisected, the Difference of the Rectangles, made by the Sides, and the Segments of the Base is equal to the Square of the Line that bisects the Angle.

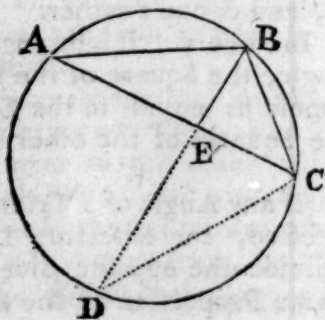
13. Triangles on the same Base, and having the same Height, that is between the same Parallel Lines, are equal.

14. Every Triangle is one half of a Parallelogram of the same Base and Height.

15. The Area of any Triangle may be had by adding all the three Sides together, and taking half the Sum; and, from that half Sum, subtracting each Side severally, and multiplying that half Sum and the Remainder continually into one another, and extracting the Square Root of the Product.

The following useful Proposition, being one of those mentioned by Sir Isaac Newton in his *Algebra*, which is necessary to be known by all those who intend to apply Algebra to Geometry; but he neither demonstrating it, nor directing where it is demonstrated, therefore I have given a Demonstration thereof.

If there be any Right Line (BE) which bisects the Angle (ABC) of



the Triangle (ABC,) I say the Square of the said Line (BE) = $AB \times BC - AE \times EC$.

Having described a Circle about the said Triangle, and continued out the Line (BE) till it cuts the Circle in (D,) and drawn the Line (DC,) the Triangles (ABE) and (BCD) will be similar, which may be thus proved. The Angle $ABE = EBC$ by Construction; and because the Angles (BAC) and (BDC) stand upon the same Arch (BC,) they will likewise be equal; and consequently the Angle AEB, BCD, must be equal: Therefore, as $AB : BE :: DB : BC$, whence $AB \times BC = BE \times DB$. But since $AB \times EC = BE \times ED$ from the Nature of the Circle. And because $BEq = DB \times BE (= AB \times BC) - ED \times BE$ from the Third of the Second of *Euclid*; therefore $AB \times BC - AE \times EC = BEq$. Q.E.D.

TRIANGULAR COMPASSES, are such as have three Legs or Feet to take off any Triangle at once.

TRIANGULAR QUADRANT, is a Sector with a loose Piece to make it an Equilateral Triangle; the Calendar is graduated on it, with the Sun's Place, Declination, and many other useful Lines; and by the Help of a String and a Plumet, and the Divisions graduated on the loose Piece, it may be made to serve for a Quadrant.

TRIANGULUS SEPTENTRIONALIS, or *Deltoton*. The Triangle, a Northern Constellation consisting of six Stars.

TRIGLIPH, in Architecture, is a Member of the *Doric Freeze*, placed directly over each Column, and at equal Distances in the Intercolumnation, having two entire Glyphes or Channels engraved

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graven in it, meeting in an Angle, and separated by three Legs from the two Demi-Channels of the Sides.

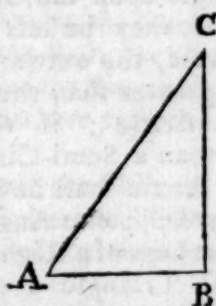
TRIGON, signifies a Figure with three Angles: And, in Dialling, is an Instrument of a Triangular Form.

TRIGONOMETRY, is either Plain or Spherical.

TRIGONOMETRY (PLAIN,) is the Art of finding, from three given Parts of a Right-lin'd Triangle, the rest. And

TRIGONOMETRY (SPHERICAL,) is the Art of finding, from three given Parts of a Spherical Triangle, the rest; as from two Sides and one Angle, the two other Angles and the third Side.

1. In all Right-angled Plane Triangles, if one of its Sides, be made the Radius, the other two will be the Sines, Tangents, or Secants, of the Acute Angles:



And whatever Proportion the Side made has to the Radius, the same has the other Sides to the Sines, Tangents, or Secants, represented by this.

As if AC be the Radius, then
 $S. BAC : BC \} \therefore Radius : Hy-$
 $S. ACB : AB \} \therefore pothen. AC.$

If the Leg AB be the Radius, then

$Radius : AB \} \therefore Sec. BAC : Hy-$
 $T. BAC : BC \} \therefore pothen. AC.$

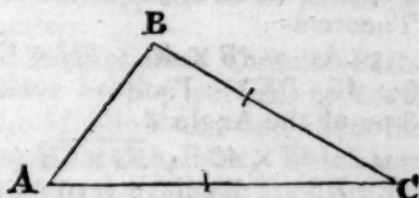
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If the Leg BC be made the Radius, then

$Radius : BC \} \therefore Sec. ACB : Hy-$
 $T. ACB : AB \} \therefore pothen. AC$

2. In any Right-lined Triangle the Sides are proportional to the Sines of the Opposite Angles,

Whence in the Triangle ACB.



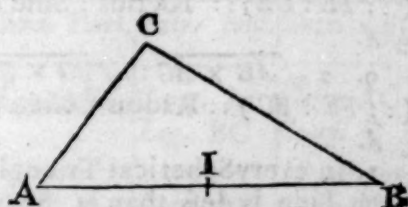
As,

$S. A \} : S. C :: \{ BC \} : AB.$
 $S. B \} : S. C :: \{ AC \} : AB.$

$S. C \} : S. B :: \{ AB \} : AC.$
 $S. A \} : S. B :: \{ BC \} : AC.$

$S. B \} : S. A :: \{ AC \} : C.$
 $S. C \} : S. A :: \{ AB \} : C.$

In every Right-lined Triangle, as ABC, as the Sum of the Sides AB, AC, about a given Angle



A is to their Difference, so is the Tangent of half the Sum of the remaining Angles B, C, to the Tangent of half their Difference.

If the Sides AC, BC, AB, of a Triangle ABC, be given, and if AB be bisected in I, and you



take

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take upon it (when both Ways produced) the Lines AE , AE , equal to AC , and BG , BH , equal to BC , and join CE , CF , and from C let fall a Perpendicular CD , to AB , supposed the Base, then will the Area $= \frac{1}{2} \sqrt{FG \times HE \times HE \times EG}$. And for determining the Angle A , there come out several Theorems:

3. As $2 AB \times AC : FH \times EG$ ($:: AC : DE$) $::$ Radius : versed Sine of the Angle A .

4. $2 AB \times AC : \sqrt{FG \times FH}$ ($:: AC : DF$) $::$ Radius : versed Cosine of A .

5. $2 AB \times AC : \sqrt{FG \times FH \times HE \times EG}$ ($:: AC : CD$) $::$ Radius : Sine of A .

6. $\sqrt{FG \times FH} : \sqrt{HE \times EG}$ ($:: CE : DE$) $::$ Radius : Tangent of $\frac{1}{2} A$.

7. $\sqrt{HE \times EG} : \sqrt{FG \times FH}$ ($:: CE : FC$) $::$ Radius : Cotangent of $\frac{1}{2} A$.

8. $2 \sqrt{AB \times AC} : \sqrt{HE \times EG}$ ($:: FE : CE$) $::$ Radius : Sine of $\frac{1}{2} A$.

9. $2 \sqrt{AB \times AC} : \sqrt{FG \times FH}$ ($:: FE : FC$) $::$ Radius Cosine of $\frac{1}{2} A$.

1. In every Spherical Triangle, each Side is less than a Semi-Circle.

2. In every Spherical Triangle, any two Sides together are greater than the third.

3. The Sum of the Sides of a Spherical Triangle is less than two Semi-Circles.

4. If two Sides of a Spherical Triangle be equal to a Semi-Circle, the two Angles at the Base shall be equal to two Right Angles; if they be less than a Semi-Circle, the two Angles shall be less; but if greater than a

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Semi-Circle, the two Angles shall be greater than two Right Angles.

5. The Sum of the three Angles of a Spherical Triangle, are greater than two Right Angles, and less than six.

6. Two Angles of any Spherical Triangle are greater than the Difference between the third Angle and a Semi-Circle. Therefore,

7. Any Side being continued, the Exterior Angle is less than the two Interior opposite ones.

8. In any Spherical Triangle the Difference of the Sum of two Angles and a whole Circle, is greater than the Difference of the third Angle and a Semi-Circle.

9. In any Spherical Triangle, one Side being produced, if the other two Sides be equal to a Semi-Circle, the outward Angle shall be equal to the inward Opposite Angle upon the Side produced: If they be less than a Semi-Circle, the outward Angle shall be greater than the inward Opposite Angle; if they be greater than a Semi-Circle, the outward Angle shall be less than the inward Opposite Angle.

10. The Legs of a Right-angled Spherical Triangle are of the same Affection with their Opposite Angles.

11. In a Right-angled Spherical Triangle, if either Leg be a Quadrant, the Hypotenuse shall be also a Quadrant; but if both the Legs be of the same Affection (that is, be both greater, or both less than a Quadrant) the Hypotenuse is less than a Quadrant; or if of different Affections, then greater, and the contrary.

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12. In a Right-angled Spherical Triangle, the Sum of the Oblique Angles are less than three Right Angles.

14. In any Spherical Triangle whose Angles are all Acute, each Side is less than a Quadrant.

15. In Spherical Triangles, there are twenty-eight Cases, sixteen in Rectangular, and twelve in Oblique Angular. The sixteen Cases of Rectangular are resolv'd by the two first of the following Theorems.

THEO. I.

In all Spherical Rectangular Triangles, having the same Acute Angle at the Base, the Sines of the Hypothenuses are proportional to the Sines of their Perpendiculars.

THEO. II.

In all Spherical Rectangular Triangles, having the same Acute Angles at the Base, the Sines of the Bases, and the Tangents of the Perpendiculars, are proportional.

That all the Cases of a Right-angled Spherical Triangle, may be resolved by these two Theorems.

The several Parts of the Spherical Triangle proposed, must sometimes be continued to Quadrants, that so the Angles may be turn'd into Sides, the Hypothenuses into Bases and Perpendiculars, and the contrary. By which Means the Proportions, as to the Parts of the Triangle given, instead of Sines, do sometimes fall in Cosines, and sometimes in Cotangents, instead of Tangents. Such Parts as do change their Proportion, are noted with

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their Complements, viz. the Hypothenuse, and both the Oblique Angles; but the Sides containing the Right Angle do not change.

These are called the Five Circular Parts of a Triangle, amongst which the Right Angle is not reckoned; and therefore the two Sides which do contain it, are supposed to be joined together.

Each of these Circular Parts, may, by Supposition, be made the Middle Part; and then the two Circular Parts, which are next to that Middle Part, are the Extrems conjunct; the other remote from the Part assumed, are the Extrems disjunct.

As in the Triangle ABC, (suppose a Triangle to be drawn,) if Comp. AC be made the Middle Part, Comp. A and Comp. C are the Extrems conjunct; and the Side AB and BC are the Extrems disjunct; and so of the rest, as in the Table following.

| Mid. Part. | Extr. conj. | Extr. disj. |
|------------|---------------------|---------------------|
| Leg. AB | Comp. A
Leg. BC | Comp. AC
Comp. C |
| Comp. A | Comp. AC
Leg. AB | Comp. C
Leg. BC |
| Comp. AC | Comp. A
Comp. C | Leg. AB
Leg. BC |
| Com. C | Comp. AC
Leg. BC | Comp. A
Leg. AB |
| Leg. BC | Comp. C
Leg. AB | Comp. A
Comp. AC |

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The Parts of a Right-angled Spherical Triangle, being thus distinguished into five Circular Parts, for the more Ease in resolving all Spherical Triangles, the Lord Napier invented this Catholick and Universal Proportion, viz.

The Sine of the Middle Part and Radius, is reciprocally proportional to the Tangents of the Extrems conjunct, and the Cosines of the Extrems disjunct.

That is, as the Radius to the Tangent of one of the Extrems conjunct, so is the Tangent of the other Extream conjunct, to the Sine of the Middle Part.

And also, as the Radius, to the Cosine of one of the Extrems disjunct, so is the Cosine of the other Extreme disjunct to the Sine of the Middle Part.

Therefore if the Middle Part be sought, the Radius must be in the first Place; if either of the Extrems, the other Extream must be in the first Place.

Only note, that if the Middle Part, or either of the Extrems conjunct, be noted with its Complement in the Circular Parts of the Triangle instead of the Sine or Tangent, you must use the Cosine or Cotangent.

If either of the Extrems disjunct be noted by its Complement in the Circular Parts of the Triangle, instead of the Cosine you must use the Sine of such Extream disjunct.

That the Directions may be better understood, there is in the Table following, the Circular Parts of a Triangle under their respective Titles, whether they be taken for the Middle Part, or for the Extrems; whether conjunct or disjunct; and unto those

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Parts there is prefix'd the Sine and Cosine, the Tangent or Cotangent, as it ought to be by the Catholick Proportion.

| Mid. Part. | Extr. conj. | Extr. disj. |
|------------|-----------------------|------------------------|
| Sine. AB | Co tan. A
Tan. BC | Sine AC
Sine C |
| Co sine A | Co tan AC
Tang. AB | Sine C
Cosine BC |
| Cosine AC | Co tan. A
Cotan. C | Cosine AB
Cosine BC |
| Cosine C | Cotan. AC
Tan. BC | Sine A
Cosine AB |
| Sine BC | Cotan. C
Tan. AB | Sine A
Sine AC |

T H E O. III.

In all Spherical Triangles, the Sines of the Sides are in direct Proportion to the Sines of their Opposite Angles, and the contrary.

T H E O. IV.

In all Oblique-angled Spherical Triangles, in which two Sides are less than a Semi-Circle,

As the Sine of half the Sum of the two Sides

To the Sine of half their Difference;

So is the Cotangent of half the contained Angle,

To the Tangent of half the Difference of the Opposite Angles.

And, as the Cosine of half the Sum of the Sides,

To the Cosine of half their Difference;

So

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So is the Cotangent of half the contained Angle,

To the Tangent of half the Sum of the Opposite Angles

T H E O. V.

In all Oblique-angled Spherical Triangles, in which two Angles are less than two Right Angles.

As the Sine of half the Sum of two Angles,

To the Sine of half their Difference ;

So is the Tangent of half the interjacent Side,

To the Tangent of half the Difference of the Opposite Sides.

And, as the Cosine of half the Sum of the Angles,

To the Cosine of half their Difference ;

So is the Tangent of half the interjacent Side,

To the Tangent of half the Sum of the Opposite Sides.

T H E O. VI.

As the Rectangle of the Sines of the containing Sides,

To the Square of the Radius ;

So is the Rectangle of the Sines of half the Sum of the three Sides, and of the Difference of the Opposite Side therefrom,

To the Square of the Cosine of half an Angle sought.

TRIANGULAR, in Geometry, is the same with a Three-sided.

TRINE, is an Aspect of the Planets, when at the Distance of 120 Degrees, or four Signs, from each other, and are noted thus Δ .

TRINGLE, in Architecture, is a little Member fixed exactly upon every Triglyph under the Plat-Band of the Architrave, from

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whence hang down the Gutturæ, or pendant Drops, in the Dorick Order.

TRINOMIAL ROOT, in Mathematicks, is a Root consisting of three Parts connected together by the Sign $+$; as $x + y + z$.

TRIPARTITION, is the Division by 3, or taking the third Part of any Number or Quantity

TRIPPLICATE RATIO, is the Ratio of the Cubes.

TRIS-DIAPASON, or *Tripple Diapason Chord*, in Musick, is what is otherwise called a *Tripple Eighth*, or *Fifteenth*.

TRITONE, a Term in Musick, which signifies a great Fourth.

TROCHILE, in Architecture, is that Hollow Ring, or Cavity, which runs round a Column next to the Tore.

TROCHLEA, is one of the Mechanick Powers, and is what we usually call the Pulley.

TROCHOID, the same with *Cycloid*. Which see.

TROPICAL YEAR. See *Year*.

TROPHY, in Architecture, is an Ornament which represents the Trunk of a Tree charged or encompassed all round about with Arms or Military Weapons, both offensive or defensive.

TROPICKS, are Circles supposed to be drawn parallel to the Equinoctial at $23^{\circ} 30'$ Distance from it ; one towards the North, is called the *Tropick of Cancer* ; and the other towards the South, is called the *Tropick of Capricorn*, because they lie under these Signs.

TRUKS of the Carriage of a Piece of Ordnance, are the Wheels which are on the Axle-Tree to move the Piece.

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TRUE CONJUNCTION. See *Conjunction True*.

TRUE PLACE of a Planet or Star, is a Point of the Heavens shewn by a Right Line drawn from the Centre of the Earth, through the Centre of the Planet or Star.

TRUNCATED PYRAMID, or Cone, is one whose Top is cut off by a Plane Parallel to its Base.

A *Truncated Cone*, or the Frustum of that Body, is called sometimes a *Curtie Cone*.

TRUNNIONS of a Piece of Ordnance, are those Nobs or Branches of the Gun's Metal which bear her up upon the Cheeks of the Carriages.

TURN, a Term belonging to the Movement of a Watch, and signifies the entire Revolution of any Wheel or Pinion.

TUSCAN ORDER, in Architecture, is the first, the most simple, and the strongest: Its Column has seven Diameters in Height; and its Capital, Base, and Entablement, have no Ornaments, and but few Mouldings.

TWILIGHT, is that faint Light which we perceive before the Sun-Rising, and after Sun-Setting. 'Tis occasioned by the Earth's Atmosphere refracting the Rays of the Sun, and reflecting them from the Particles thereof.

The Sun's Depression below the Horizon, at the Beginning and End of the Morning and Evening Twilight, was observed by *Alhazen* 19° . *Tycho* 17° . *Rothmem* 24° . *Stevinus* 18° . *Cassini* 15° . *Ricciolus*, at the Time of the Equinox in the Morning 16° . in the Evening 20° . 30° . In the Summer Solstice in the Morning 21° . 25° . and in the Winter 17° .

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15° . Whence it appears that the Cause of the Twilight is instant: But about 18 Degrees of the Sun's Depression will, in our Latitude, be the Beginning and End of the Twilight.

TYMPAN, in Architecture, is that Part of the Bottom of the Frontons, which is enclosed between the Cornices, and answers the Naked of the Freze.

TYMPAN of an Arch, is a Triangular Table placed in its Corners.

V.

VACUUM, is by Physiologists, supposed to be a Space devoid of all Body; and this they distinguish into a *Vacuum Disseminatum*, or *Interspersum*, i. e. small void Spaces interspersed about between the Particles of Bodies; or, a *Vacuum Coacervatum*, which is a larger void Space made by the meeting together of the several Interspersed or disseminate Vacuities before mentioned.

VANE. Those Sights which are made to move and slide upon Cross-Staves, Fore-Staves, Davis's, Quadrants, &c.

VAPOURS, are Watry Exhalations raised up either by the Heat of the Sun, the Subterranean, or any other accidental Heat, Fire, &c.

VARIATION, is, according to *Tycho*, the third Inequality in the Motion of the Moon; and arises from her Apogæum being changed as her System is carried round the Sun by the Earth.

VARIATION of the Needle, or Compass, is the Deviation or Turning of the Magnetical Needle in the Mariner's Compass, from the true North-Point, which happens more or less in most Places; and is commonly called by the Seamen the *North-Easting*, or *North-Weasting* of the Needle.

VECTIS, or the Lever, is the First of the Mechanick Powers, as they are usually called.

VENT, in Gunnery, signifies the Distance between the Diameter of a Bullet, and the Diameter of the Bore of the Piece, and must be one twentieth Part of the Diameter of the Bore.

VELOCITY. See *Celerity*.

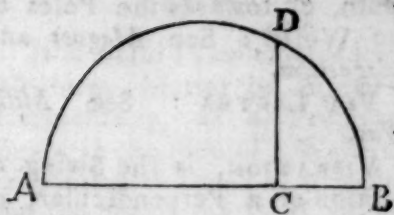
VENUS, the Name of one of the Planets, being the second from the Sun.

The Distance of *Venus* from the Sun is 723, its Excentricity 5, the Inclination of its Orbit 3 Degrees, and 23 Minutes: It performs its Periodical Motion in 224 Days, 17 Hours; and its Motion round its Axis is performed in 23 Hours. The Diameter of it is almost equal to the Earth's Diameter.

In the Years 1672 and 1686 *Cassini*, with a Telescope of 34 Foot long, believes he saw a Satellite moving round this Planet, and distant from it about $\frac{2}{3}$ of *Venus's* Diameter. It had the same Phasis with *Venus*, but was without any well designed Form, and its Diameter scarce exceeded $\frac{1}{4}$ of that of *Venus*.

VERSED SINE of an Arch, is a Segment of the Diameter of a Circle, lying between the Foot of the Right Sine and the Lower Extremity of the Arch.

As *AD* is the Versed Sine of the Arch *AC*, and *BD* the Ver-



fed Sine of the Arch *CB*.

VERTEX, is that Point of the Heaven just over our Heads, and the same with *Zenith*; which see.

The Point of any Angle is called also its Vertex, and that Point of the Curve of a Conick Section, where the Axis cuts it, is called also the Vertex of that Section.

VERTEX, of a Cone, or Pyramid, &c. is the Point of the upper Extremity of the Axis, or the Top of the Figure: So the Vertex of an Angle, is the Angular Point; and those Angles which, being opposite to one another, do touch only in the Angular Point, are called Vertical Angles.

VERTEX of a Glass, in Opricks, is the same with its Poles; which see.

VERTICAL CIRCLES: See *Azimuths*.

VERTICAL LINE: See *Line Vertical*.

VERTICAL OPOSITE ANGLES: See *Angles*.

VERTICAL PLANE, in Perspective: See *Plane*.

VERTICAL POINT, the same with Vertex: So that in Astronomy, a Star is said to be Vertical, when it happens to be in that Point which is just over any Place.

VERTICITY, the Property of the Loadstone, or a touched Needle, to point North and South,
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South, or towards the Poles of the World : See *Magnet* and *Magnetism*.

VIA LACTEA : See *Milky Way*.

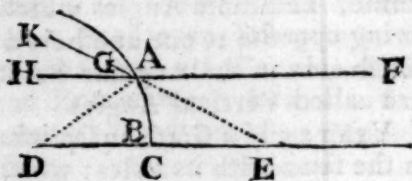
VIBRATION, is the Swing or Motion of a Perpendicular, or of a Weight hung by a String on a Pin.

VINDEMATRIX, a fixed Star of the third Magnitude, in the Constellation *Virgo*, whose Longitude is 185 Degrees and 23 Minutes, Latitude 16 Degrees and 15 Minutes.

VIRGO, one of the twelve Signs of the Zodiack, being the Sixth according to Order.

VIRTUAL FOCUS, or Point of Divergence in a Concave Glass, is the Point *E* in the following Figure.

Let the Concavity of the Glass be *ABC*, and its Axis *DE*: Let



FG be a Ray of Light falling on the Glass, parallel to the Axis *DE*; and let *D* be the Centre of the Arch *ABC*: This Ray *FG*, after it hath passed the Glass, at its Emerſion at *G* will not proceed directly to *H*, but be refracted from the Perpendicular *DG*, and will become the Ray *GK*; draw directly *GK*, so as that it may croſs the Axis in *E*, ſo found. Mr. *Molynæus* calls it the *Virtual Focus*, or *Point of Divergence*.

VISIBLE HORIZON : See *Horizon*.

VISIBLE PLACE of a Star: See *Apparent Place*.

VISION, is a Sensation in the Brain, proceeding from a due and various Motion of the Optick Nerves, produced in the Bottom of the Eye, by the Rays of Light coming from any Object; by which Means the Soul perceives the illuminated Thing, together with its Quantity, Quality, and Modification.

VISUAL POINT, in Perspective, is a Point in the Horizontal Line, wherein all the Ocular Rays unite.

VISUAL RAYS: See *Rays*.

VITRIOUS HUMOUR, or Glassy Humour of the Eye, is the third Humour of the Eye, ſo called from its Reſemblance of a melted Glass: 'Tis thicker than the Aqueous, but not ſo ſolid as the Chriſtalline: 'Tis round or convex behind, and ſomewhat plain before, only hollow'd a little in the Middle, where it receives the Chriſtalline. It exceeds both the other Humours in Quantity.

UMBILICUS, the ſame as *Focui*.

UMBILICK POINTS, the ſame as *Focus*.

UNCIAE, in Algebra, are thoſe Numbers which are prefixed before the Letters of the Members of any Power produced from a Binomial, Reſidual, or Multinomial Root.

Thus in the fourth Power of $a + b$, that is, $aaaa + 4aaab + 6aabb + 4abbb + bbbb$, the Unciæ are 4, 6, 4.

UNIFORM MATTER, is that which is all of the ſame Kind and Texture.

If there be a Right-angled Parallelopipeden of Uniform Matter, ſupported horizontally by two Fulcrums at its Ends, its Diſ-

Disposition to break in any Part (or Point) of it by its own Gravity, will be as the Rectangle under the Distance of that Part (or Point) from each Fulcrum; and so its Disposition to break in the Middle will be greatest, since that Rectangle there becomes a Maximum.

This is true of *Cylinders* and *Prisms* likewise.

The same Thing being supposed when the Length and Breadth, and the Parallelopipeden remain the same, its Disposition to break in the Middle (or at any other Point at the same Distance from the Fulcrums) will always be as the Square of the Height; and so the Strength of a Parallelopipeden, laid edge-ways upon the Fulcrums to its Strength when laid flat-ways, will be as the Height in one Cape, is to the Height in the other.

From what has been said, if the Upper Face of the Parallelopipeden, lying horizontally upon the two Fulcrums, be changed into a Curve Surface, being such that all the Sections of the Solid, made by Planes perpendicular to the Horizon, and parallel to one of its Sides, be Semi-Elliptick Spaces of the same Magnitude, whose transverse Axes are the Lengths of the Solid, and Semi-Conjugate the Height in the Middle: This Solid will have the same Disposition to break in all its Parts; and so Joists, &c. cut after this Figure, will be as strong as when they are of the same Height all the Way as this Solid has in the Middle; and consequently the Timber saved by cutting a Joist in Figure of this Solid, will be about three Parts out of fourteen.

If a Solid Parallelopipeden of Uniform Matter be supported Horizontally, as a Prominent Beam in the Side of a Wall, the Disposition to Break of that Part coming out of the Wall in any Place by the Weight of the whole Prominent Part, will always be as the Distance of that Place from the End of the Prominent Part; and so its Disposition to break at the Wall will be greatest.

And if the Upper Surface of the Prominent Part be changed into a Curve Surface, such that all Sections of it, by Planes parallel to the upright Faces of the Solid, and perpendicular to the Horizon, are equal Semi-Parabolas, having their Axes in the under Surface, and Vertexes in the lower Side of the End-Face of the Solid, which is parallel to the Wall, then this Prominent Solid will have the same Disposition to break in any Part of it, that is, it will as soon break in one Part as the other; and so there may be $\frac{1}{2}$ Part of the Matter saved by cutting it into this Solid; and yet it will be as strong as a Parallelopipeden, of the same Length, Breadth, and Height (that it has at the Wall) with itself, provided it be of the same Uniform Matter.

UNIFORM MOTIONS, are the same with equal, or rather equable ones; which see.

UNISON, is one and the same Sound.

UNITE, or Unity, is the same as one, or 1.

UNIVERSAL EQUINOCTIAL DIAL, is one consisting of two Rings of Brass, or Silver, that open and fold together, with a Bridge or Axis, and a Slider, and

a little Ring to hang or hold it up by : It is divided on one Side of the great Ring into 90 Degrees, and sometimes on the other, into two Quadrants, or 180 Degrees, but one is enough. The innermost Ring is divided into 24 Hours, subdivided on the Face, and on the Outside of the Ring, into every 5 Minutes. The Axis has the Sun's Declination on one Side, and the Day of the Month, and the Sun's Place on the other.

To use it for the Hour, the Perpendicular Line, or Stroke, which is on the Slider, which moves on the outer Ring, must be set to the Latitude of the Place, and the Hole in the Slider, or the Bridge, either to the Sun's Place in the Ecliptick, the Day of the Month, or his Declination ; and then the Rings being open'd, and set square to one another, move the Dial about, too and fro, till the Sun shines through the Hole, and on the inner Edge of the innermost Ring ; and there it will shew the true Hour.

The Hour of 12 cannot be shewn by this Dial, because the outermost Circle, or Ring, being then in the Plane of the Meridian, it hinders the Rays of the Sun from falling upon the innermost or Equinoctial Circle. And when the Sun is in the Equinoctial, you cannot tell the Hour of the Day by this Instrument, because at that Time his Rays fall parallel to the Plane of the said Equinoctial Circle : But this is but about one Hour every Day, and four Days in the Year.

UNIVERSAL PROBLEM, the same as *Indeterminate Problem*.

VOLUTE, in Architecture, is one of the principle Ornaments

of the *Ionic* and *Composite Capitals*, representing a kind of Bark wreathed or twisted into a Spiral Scroll. There are eight Angular Volute in the *Corinthian Capital*, and these are accompanied with eight other little ones, called *Helices*.

VORTEX, according to the *Cathestian Philosophy*, is a System of Particles of Matter moving round like a Whirl-Pool, and having no void Interstices, or Vacuities between the Particles.

UPRIGHT SOUTH DIALS. See *Prime Verticles*.

URSA MAJOR, a Northern Constellation, consisting of 27 Stars, and is otherwise called *Charles's Wain*, and the *Great Bear*.

VULGAR FRACTIONS. See *Fractions*.

W

WADHOOK, among the Gunners, is a Rod or great Wire of Iron, turned in a Serpentine Manner ; and its end is put upon a handle or Staff, to draw out Wads, or Okum, that the Piece may be unloaded.

WAGONER. See *Charles's Wain*.

WARNING-WHEEL, in a Clock, is the third or fourth Wheel, according to its Distance from the first Wheel.

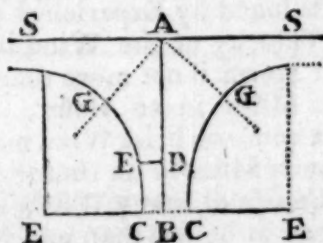
WATER, is a very fluid Volatile and tasteless Salt, very probably consisting of Hard, Smooth, Pondrous, Spherical Particles, of equal Diameters, and of equal Specifical Gravities.

The Porosity of Water is so very great, that there is at least forty Times as much Space as Matter in it ; for Water is nineteen

teen Times specifically lighter than Gold, and so rarer in the same Proportion; but Water can be pressed through the Pores of Gold, and therefore may be supposed, at least, to have more Pores than Solid Matter.

The Motion of Water running out of a Hole in a Vessel may be thus defined.

Let *SAS* be an Infinite Superficies of Water, *CC* a Circular Hole made in the Bottom of a Vessel, *AB* a Straight Line drawn perpendicular through the Hole. *SGCC* a Column or Cataract of Water running out through the Hole *CC*, *SGC* a Curve, by the Rotation of which, about the Axis *AB*, the Solid or



Cataract *SGCCS* is generated; for since the Water descends freely, and with an accelerate Motion, it must of Necessity be contracted into a less Breadth, according as in falling it requires a greater Velocity, and will run out through the Hole *CC* with the same Velocity that it would have in Falling the Height *AB*.

Now the Velocity that a heavy Body acquires by falling, is in the Subduplicate Ratio of the Height from whence it falls: Wherefore if any Ordinate *DE* be drawn to the Curve *SGC*, and *DE* be called *y*, and *AB*, *x*; then the Velocity of the Water, in the Section *ED*, will be ex-

pressed by \sqrt{x} , and the Product of that Velocity drawn into the said Section by $\sqrt{x} \times y^2$.

Which Product is as the Quantity of Water passing thro' that Section in a given Space of Time, and because the same Quantity of Water passes through each Section of the Cataract in a given Time, that Product will be always equal to itself; and so $\sqrt{x} \times y^2 = 1$, and $x \times y^4 = 1$ which is an Equation of the Curve *SGC*, being an Hyperbola of the 4th Order, one of the Asymptotes being the Right Line *AS* parallel to the Horizon, and the other the Line *AB* perpendicular to it.

The Power of it is the Quadrate Cube of the Ordinate *ED* drawn to the Point *G*, where the Right Line *AG* bisecting the Angle, formed by the Asymptotes, meets the Curve.

If Water runs out through a Circular Hole in the Bottom of a Vessel of an Infinite Breadth, the Motion of the whole Cataract of Water towards the Horizon, is equal to the Motion of a Cylinder of Water under the Hole itself, and Height of the Water, the Velocity of which will be equal to the Water running out through the Hole, or equal to the Motion of a Quantity of Water, which runs out in a given Time, the Velocity of which will be equal to that which is acquired in that same given Time by the Motion, through the Space, equal to the Height of the Water.

If $BA:BD::DG^4:DG^4-BC^4$. and Water runs out through *CC* a Circular Hole made in the Middle of the Bottom of a Cylindrical Vessel *GGEE* constantly full of Water, the Motion of a Cataract

W E

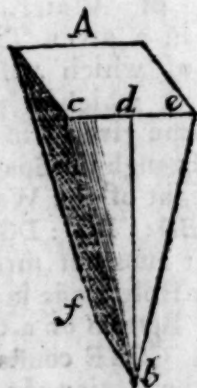
of Water towards the Horizon, shall be equal to the Motion of a Cylinder of Water under the Hole, and the Height *AB*, whose Velocity shall be equal to the Velocity of the Water running out through the Hole; or it shall be equal to the Quantity of Water which runs out in a given Time, with such a Velocity as is acquired in that same given Time to move through a Space equal to the Height *AB*; and if the Vessel and Hole be of any other Figure, the Motion of the Cataract of Water will be the same, using a Proportion of Water of the Height *AB* for a Cylinder.

Way of the Rounds, in Fortification, is a Space left for the Passage of the Rounds between the Rampart and the Wall of a fortified Town: But it is not so much in use, because not having a Parapet above a Foot thick, it may be soon overthrown by the Enemies Cannon.

WEDGE, is a Prism of a small Height, whose Bases are *Æquicural* Triangles, as *A*.

The Height of the Triangle is the Height of the Wedge, as *db*.

The Base of the Triangle is called the Base of the Wedge, as *ce*.



W I

The Edge of the Wedge is a Right Line, which joins the Vertices of the Triangles, as *bf*.

The Edge of the Wedge is applied for cleaving of Wood, and the Power is the Blow of a Hammer, or Mallet, which drives the Wedge into the Wood.

The Power is to the Resistance of the Wood, when its Action is equal to it, as the Half-Base of the Wedge is to its Height.

WIND, is any sensible Agitation of the Air, and is caused by the Action of the Sun's Beams upon the Air and Water, as he passes every Day over the Ocean, considered together with the Nature of the Soil and Situation of the adjoining Continents.

It is found by Experience that the Velocity of the Wind in a great Storm is not more than 50 or 60 Miles in an Hour, and that a common brisk Wind moves about 15 Miles in an Hour: And the Course of many Winds is so slow as to be less than one Mile in an Hour.

WINGS, in Fortification, are the large Sides of Horn-Works, Crown-Works, Tenails, and the like Out-Works, that is to say, the Ramparts and Parapets, with which they are bounded on the Right and Left, from their Gorge to their Front. These Wings or Sides are capable of being flank'd either with the Body of the Place, if they stand not too far distant, or with certain Redoubts, or with a Traverse, made in their Ditch.

WINTER SOLSTICE. See *Solstice*.

Y

YEAR, is the Time the Sun takes to go through the twelve Signs of the Zodiack. This is properly the Natural or Tropical Year, and contains 365 Days, 5 Hours and 12 Minutes.

The Sydereal Year is that Time in which the Sun, departing from any fixed Star, comes to it again; and this is in 365 Days, 6 Hours, and almost 10 Minutes: But according to Sir *Isaac Newton's Theory of the Moon*, the Sydereal Year, is 365 Days, 6 Hours, 9 Minutes, 14 Seconds, and the Tropical 365 Days, 5 Hours, 48 Minutes, 57 Seconds.

Z

ZENITH. If we conceive a Line drawn through the Observer and the Center of the Earth, which must necessarily be perpendicular to the Horizon, it will reach to a Point among the fixed Stars, which is called the *Zenith*.

ZENITH DISTANCE, is the Complement of the Sun, or Star's Meridian Altitude, or what the Meridian Altitude wants of 90 Degrees.

ZETETICK METHOD, in Mathematics, is the Analytick or Algebraick Way, whereby the Nature and Reason of the Thing is primarily investigated and discovered.

Zocco. See *Plinthus*.

ZOCLE, in Architecture, is a Square Pody, less in Height than Breadth, and placed un-

der the Bases of the Pedestals of Statutes, Vases, &c.

ZODIACK, is a Zone or Belt which is imagined in the Heavens, which the Ecliptick Line divides into two equal Parts; and which, on either Side, is terminated by a Circle parallel to the Ecliptick Line, and eight Degrees distant from it, on Account of the small Inclinations of the Orbits of the Planets, to the Plane of the Ecliptick: No Bodies of the Planetary System appear without the Zodiack.

ZODIACK of the Comets, is a certain Tract in the Heavens, within whose Bounds most Comets are observed to keep their Course.

ZONE, in Geography, is a Space contained between two Parallels.

The Whole Surface of the Earth is divided into five Zones. The First is contain'd between the two Tropicks, and is called the *Torrid Zone*. There are two Temperate Zones, and two Frigid Zones. The Northern Temperate Zone is terminated by the Tropick of Cancer; and the Arctick Polar Circle, the Southern Temperate Zone is contained between the Tropick of Capricorn, and the Polar Circle: The Frigid Zones are circumscribed by the Polar Circles; and the Poles are in the the Centres of them.

In the *Torrid Zone*, twice a Year the Sun goes through the Zenith at Noon; for the Elevation of the Pole is less than 23 Degrees, 29 Minutes, and the Distance of the Sun from the Equator towards the Pole, which is above the Horizon, is twice in a Year equal to the Height of the

the Pole ; for which Reason also, in the Limits of that Zone, namely under the Tropicks, the Sun comes to the Zenith only once in a whole Year.

In the Temperate and Frigid Zones, the least Height of the Pole exceeds the greatest Distance of the Sun from the Equator, and therefore, to their Inhabitants, the Sun never goes through the Zenith ; yet if on the same Day the Sun rises at the same Time to a greater Height, the less the Height of the Pole is, because thereby the Inclination of the Circles of the Diurnal Revolution with the Horizon is less.

In the Torrid Zone, and in the Temperate Zones, every Natural Day the Sun rises and sets ; for the Distance of the Sun from the Pole always exceeds the Height of the Pole ; yet every where, but under the Equator, the Artificial Days are unequal to one another, which Inequality is so much the greater, the less the Place is distant from a Frigid Zone.

But in the Polar Circles, just where the Temperate Zones are separated from the Frigid ones, the Height of the Pole is equal to the Distance of the Sun from the Pole, when it is in the Neigh-

bouring Tropick ; and therefore, in that Case, once a Year, the Sun in its Diurnal Motion performs one entire Revolution, without going down under the Horizon.

But every where in a Frozen Zone, the Height of the Pole is greater than the least Distance of the Sun from the Pole ; therefore, during some Revolutions of the Earth, the Sun is at a Distance from the Pole, which is less than the Pole's Height ; and, during all that Time, it does not set, nor so much as touch the Horizon ; but where the Distance from the Pole, as the Sun recedes from it, does exceed the Height of the Pole or Latitude of the Place, the Sun rises or sets every Natural Day. Then in its Motion towards the opposite Pole, it stays in the same Manner before the Horizon, as was said of the Motion above the Horizon.

These Times in which the Sun makes entire Revolutions above the Horizon, and below it in its Diurnal Motion, are so much the greater, that is, the longest Day and Night last the longest, the less the Place in the Frigid Zone is distant from the Pole, till, at last, at the Pole itself, they take up the Time of the whole Year.

FINIS.



E R-

E R R A T A.

Algebraick Curve, *Line* 31. for *df*, read *dsf*; *ibidem*, *l.* 32. *f.* *b, d*, *r.* *b, c, d*; Angle of Contact, *l.* 16. *dele* the Angle of Contact; Angle of Refraction, *l.* 15. *dele* that is; Apparent Place of an Object, *l.* 9. *dele* the; Approximation in Arithmetick, *l.* 9. *f.* Howard, *r.* Ward; Areometer, *l.* 22. *f.* Hermberg, *r.* Homberg; Astragal, *l.* 4. *f.* first, *r.* Fust; Atmosphere, *Nº* 2. *l.* 11. *f.* Novo, *r.* Nova; Axis (Conjugate) or Second of an Hyperbola, *l.* 10. *f.* $VAM \times PM : AP :: 2MN : EF$, *r.* $AM \times PM : AP^2 :: MN^2 : EF^2$; Barometer, *l.* 24. *f.* 30. *r.* 31; Base, the least Sort of Ordnance, *l.* 6. *f.* $1\frac{1}{2}$, *r.* $1\frac{1}{8}$; Bissextile, *l.* 11. *f.* 24th, *r.* 28th; Burning-Glasses, *l.* 69. *f.* 24 Inches, *r.* 44; Catacousticks, *l.* 4. *f.* Proportions, *r.* Properties; Centre of Oscillation, *l.* 21. *f.* form, *r.* from; Centripetal Force, *l.* 26. *f.* *ST*, *r.* *QT*; *ibidem*, *l.* ult. *f.* $\frac{CG^2}{RP^2}$ *r.* $\frac{CG^3}{RP^2}$; Characters (Mathematical) *l.* 113. *f.* Panes, *r.* Planes; Common Measure (Greatest,) *l.* 5. *f.* 8. 12. *r.* 6 of 12; Compasses of Proportion, *l.* 12. *f.* Section, *r.* Sector; Conchoid, *l.* 9. *f.* *BD*, *r.* *QQ*; *ibidem*, *l.* 23. *f.* Fluxion, *r.* Flexion; Cone, *l.* 24. *dele* lined; Contrate-Wheel, *l.* 3. for Crown, *r.* Crown-Wheel; Convex-Glass, *Nº* 5. *l.* 3. *f.* pointed, *r.* painted; Cosine, *l.* 1. *f.* Line, *r.* Sine; Cross-Multiplication, *l.* 14. *f.* Inches, *r.* Feet; Cycloid, *Nº* 4. *l.* 4. *f.* *AH*, *r.* *aH*; Decimal Fraction, *l.* 11. *f.* $\frac{346}{10000}$ *r.* $\frac{346}{1000}$; Declination of the Sun, *l.* 12. *f.* Mastilia, *r.* Massilia; Eclipse, *l.* 7. *f.* Sight, *r.* Light; Epocha, *l.* 16. *f.* Abyltium, *r.* Abyssyn; Extreme and Mean Proportion, *l.* 28. *f.* Distance, *r.* Difference; Fortification Temporary, *Nº* 11. *l.* 1. *f.* impossibly, *r.* impossible; Fraction, *Nº* 6. *l.* 4. *f.* $\frac{10}{30}$ *r.* $\frac{10}{15}$; Gravitation, *Nº* 9. *l.* 19. *dele* Contract; Heat, *Nº* 12. *l.* 5. *f.* arise, *r.* arises; Heptagon, *l.* 2. *f.* several, *r.* seven; Hour Circles, *l.* 12. *f.* perpendicular, *r.* perpendicular; Hyperbola, *Nº* 2. *l.* 12. *f.* *D*, *r.* *G*; *ibidem*, *l.* 18. *f.* Points, *r.* Pins; *ibidem*, *Nº* 4. *l.* 10. *f.* (*a*, *r.* *ca*); *ibidem*, *Nº* 5. *l.* 8. *f.* *RQ*, *r.* *RA*; Hyperbolick Space, *l.* 6. *f.* $QP = x$, *r.* $QP = y$; Impervious, *l.* 5. *f.* do, *r.* to; Index, *l.* 15. *f.* one, *r.* two; *ibidem*, *l.* 39. *f.* $1. r. \frac{1}{2}$; Inflexion Point, *Nº* 2. *l.* 67. *f.* $\frac{x}{t} \frac{y}{t}$ *r.* $\frac{x}{t} \frac{y}{t}$ Interstellar, *l.* 15. *f.* great, *r.* greater; Isochrone, *l.* 4. *f.* Springs, *r.* Swings; *ibidem*, *Nº* 3. *l.* 10. *dele* will; Interest, *l.* 2. *f.* Lot, *r.* Loan; Light, *l.* 122. *f.* pellucid, *r.* pellucid; Locus, *Nº* 5. *l.* 15. *f.* gx ; *r.* gx ; Logarithms, *Nº* 4. *l.* 4. *dele* o; Logarithmick Spiral, *l.* 11. *f.* *AP*, *r.* *AM*; Longimetry, *l.* 2. of Lengths, *r.* of the Lengths; Longitude, *Nº* 1. *l.* 3. *f.* greatest, *r.* great; *ibidem*, *Nº* 4. *l.* 5. *f.* for, *r.* from; Magnet, *l.* 2. *f.* Altros. *r.* Altorf. Maximis, *Nº* 1. *l.* 3. *f.* any, *r.* an; Measure of a Solid, *l.* 2. *f.* Circle, *r.* Cube; Mercator's Chart, *l.* 141. *dele* the Distance; *ibidem*, *l.* 179. *dele* of; *ibidem*, *l.* 181. *f.* *AB*, *r.* *ab*; *ibidem*, *l.* 206. *dele* of; Meridian Line, *l.* 2. *f.* Meridians, *r.* Meridian; *ibidem*, *Nº* 1. *l.* 44. *f.* it, *r.* them; *ibidem*, *l.* 1. *f.* or, *r.* on. Microscope, *Nº* 8. *l.* 1. *f.* Appearance, *r.* Appearances; Milky Way, *l.* 87. *f.* appears, *r.* appear; Moments, *Nº* 1. *l.* 4. *f.* by, *r.* in; Month, *Nº* 4. *l.* 17. *f.* Month, *r.* Moon; Opacous Bodies, *l.* 13. *f.* ether, *r.* other; Parabola, *Nº* 1. *l.* 17. *f.* *aaa*, *r.* *aa*; *ibidem*, *l.* 21. *f.* *EG*, *r.* *EF*; *ibidem*, *l.* 32. *f.* (*aa*) *r.* (*aa*); *ibidem*, *l.* 35. *f.* *EC*, *r.* *LC*; *l.* 39. *f.* *CD*, *r.* *ID*; *ibidem*, *Nº* 2. *l.* 22. *f.* pert, *r.* part; Parabola's of the higher Kind, *f.* $m^{m-1}x + y^m$, *r.* $a^{m-1}x = y^m$.



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